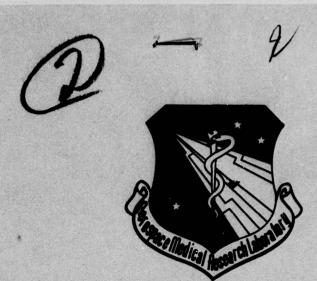
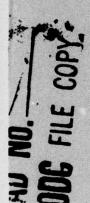


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AMRL-TR-75-50 Volume 92





USAF BIOENVIRONMENTAL NOISE DATA HANDBOOK

Volume 92

F-14A Aircraft, Far-Field Noise

JUNE 1977



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AEROSPACE MEDICAL RESEARCH LABORATORY AEROSPACE MEDICAL DIVISION AIR FORCE SYSTEMS COMMAND WRIGHT-PATTERSON AIR FORCE BASE, OHIO 45433

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This technical report has been reviewed and is approved for publication.

FOR THE COMMANDER

HENNING E. VON GIERKE

Director

Biodynamics and Bioengineering Division Aerospace Medical Research Laboratory

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BEFORE COMPLETING FORM REPORT DOCUMENTATION PAGE 2. GOVT ACCESSION AMRL-TR-75-50 - VOL - 92 Technical Para Santingo USAF BIOENVIRONMENTAL NOISE DATA HAND-BOOK F-14A Aircraft, Far-Field Noise. Volume 92 of a series 6. PERFORMING ORG. REPORT NUMBER Volume 92 . AUTHOR(s) 8. CONTRACT OR GRANT NUMBER(*) Robert G. Powell PERFORMING ORGANIZATION NAME AND ADDRESS Aerospace Medical Research Laboratory Aerospace Medical Division, Air Force 62202F 7231 -04 - 33Systems Command, Wright-Patterson AFB, OH 11. CONTROLLING OFFICE NAME AND ADDRESS Same as above 14. MONITORING AGENCY NAME & ADDRESS(II different from Controlling Office) 15. SECURITY CLASS. (of Unclassified 15a. DECLASSIFICATION/DOWNGRADING 16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited. 17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report) MAY 10 1978 18. SUPPLEMENTARY NOTES 19. KEY WORDS (Continue on reverse side if necessary and identify by block number) F-14A Aircraft Noise Environments Bioenvironmental Noise Aircraft 20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The USN F-14A is a carrier-based fighter aircraft powered by two TF30-P-412 turbofan engines. This report provides far-field measured and extrapolated data defining both physical and psychoacoustic measures of the bioacoustic environments produced by this aircraft operating on a ground runup pad for five engine/power conditions. Far-field data measured at 18 locations are normalized to standard meteorological conditions and extrapolated from 75-DD 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

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8000 meters to derive sets of equal-value contours as a function of angle and distance from the source. These contours are measures of: overall and band sound pressure levels, C-weighted and A-weighted sound levels, preferred speech interference level, perceived noise level, and limiting times for total daily exposure of personnel with and without standard Air Force ear protectors. Refer to Volume 1 of this handbook, "USAF Bioenvironmental Noise Data Handbook, Vol 1: Organization, Content and Application", AMRL-TR-75-50(1) 1975, for discussion of the objective and design of the handbook, the types of data presented, measurement procedures, instrumentation, data processing, definitions of quantities, symbols, equations, applications, limitations, etc.

PREFACE

This report was prepared by the Biodynamic Environment Branch, Aerospace Medical Research Laboratory, under Project/Task 723104, Measurement and Prediction of Noise Environments of Air Force Operations.

The author gratefully acknowledges Mr. John Cole for his assistance in preparing this report, Capt Nick Farinacci, for his assistance in acquiring the raw data, Mr. Keith Kettler, Mr. Henry Mohlman and Mr. David Eilerman of the University of Dayton for assistance in the mechanics of data processing, and Mrs. Peggy Massie and Mr. Mike Patterson for assistance in typing and preparation of the graphics.

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INTRODUCTION

The USN F-14A is a carrier-based fighter aircraft powered by two TF30-P-412 turbofan engines. The aircraft was manufactured by the Grumman Aerospace Corporation and the engines by the Pratt and Whitney Aircraft Division of United Aircraft Corporation.

This volume provides measured and extrapolated data defining bioacoustic environments produced by this aircraft during ground runup operations. Such data are essential to evaluate ear protection requirements, limiting personnel exposure times, voice communication capabilities, and annoyance problems associated with ground runups of the F-14A aircraft.

This volume is one of a series published by the AMRL under the same report number (AMRL-TR-75-50) as a multi-volume handbook that quantifies the noise environments produced at flight/ground crew locations and in surrounding communities by operations of Air Force or Navy aircraft and ground support equipment. The far-field, community-type, noise data in the handbook describe the noise produced during ground operations of aircraft, ground support equipment, and other ground-based equipment or facilities.

Volume 1 of this handbook discusses the objectives and design of the handbook, the types of data presented, measurement procedures, instrumentation, data processing, definitions of quantities, symbols, equations, applications, limitations, etc. Volume 2 provides a method and data for adjusting the handbook's far-field noise data, which are for standard meteorological conditions (15 C temperature, 70% relative humidity, 0.760 meter Hg barometric pressure), to derive comparable data for other meteorological conditions. Refer to Volumes 1 and 2 (references 1 and 2) for such information because it is not repeated in other handbook volumes.

A cumulative index lists those aerospace systems contained in the handbook, and identifies the specific volumes containing each type of environmental noise data available (i.e., inflight/flight crew and passenger noise, near-field/ground crew noise, far-field/community noise). Volume numbers are assigned sequentially as individual volumes are published. This index is periodically updated as individual volumes are published and is available upon request from AMRL/BBE, Wright-Patterson AFB, OH 45433. Organizations on the distribution list for the handbook will automatically receive a copy of each updated index.

Direct any questions concerning the technical data in this report and other handbook volumes to: AMRL/BBE, Wright-Patterson AFB, OH 45433, AUTOVON 78-53675 or 78-53664; Commercial (513) 255-3675 or (513) 255-3664.

Cole, John N., USAF Bioenvironmental Noise Data Handbook, Volume 1: Organization, Content and Application, AMRL-TR-75-50 (1) Aerospace Medical Research Laboratory, Wright-Patterson Air Force Base, Ohio, 1975.

Cole, John N., USAF Bioenvironmental Noise Data Handbook, Volume 2: Procedure to Evaluate Effects of Non-standard Meteorological Conditions on Far-Field Noise, AMRL-TR-75-50 (2), Aerospace Medical Research Laboratory, Wright-Patterson Air Force Base, Ohio, 1975.

FAR-FIELD NOISE

MEASUREMENTS

AMRL acquired the far-field data during a 1-hour test period, thus keeping similar meteorological conditions throughout the test. Figure 1 shows the ground runup area, ground cover, aircraft orientation and microphone measurement sites on the semicircle. The center of the 75 meter radius semicircle used in surveying the TF30-P-412 engines was on the ground directly below the intersection of the aircraft's centerline and the plane passing through both engines' exhaust-nozzle exits. The ground runup area did not have a blast deflector; therefore, the engines' exhausts were in a "free-flow" condition.

Table 1 provides cockpit readouts of engine characteristics (RPM, fuel flow, etc.) for each power setting used in the far-field tests. Also listed in this table are the surface meteorological conditions during data aquisition.

All microphone measurement sites are in the acoustic far-field of the source where the sound wavefronts spherically diverge and the noise source may be regarded as a point source.

A portable microphone/tape-recorder system was used to sequentially record the noise at each far-field location. The microphone was attached to a hand held pole, pointed at the source (0° angle of incidence) and vertically scanned from 0.5 to 3 meters for a period of 5-10 seconds during data acquisition at each microphone location. These samples were then time-integrated to derive a root-mean-square sound pressure level. Vertical scanning and time-integrating together reduce anomalies frequently present in data acquired by a fixed height microphone.

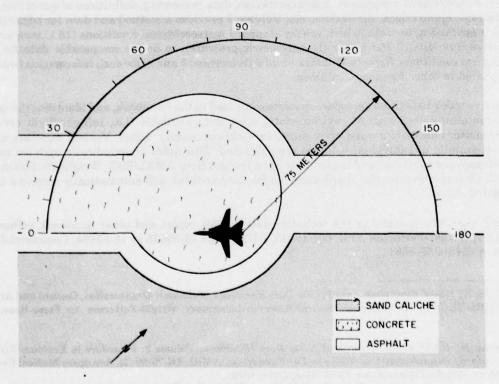


Figure 1. Far-Field Measurement Locations on Pad 18 Edwards AFB, CA

TABLE 1

TEST CONDITIONS FOR FAR-FIELD NOISE MEASUREMENTS

F-14A Aircraft, Ground Runups, Edwards AFB, CA Tail #158615, 16 July 1973

Aircraft Engine Operation

Both Engines 70 % RPM, Core Speed 590 C, Turbine Inlet Temperature 950 LBS/HR, Fuel Flow

80% Runup (#1 Engine Idle) #2 (Starboard) Engine 80 % RPM, NC 610 C, TIT 1500 LBS/HR, FF

80% Runup

80 % RPM, NC 630 C, TIT 1600 LBS/HR, FF

Military
(#1 Engine Idle)

#2 (Starboard) Engine 102 % RPM, NC 1180 C, TIT 7200 LBS/HR, FF

Afterburner, Zone 3 (#1 Engine Idle)

#2 (Starboard) Engine 102 % RPM, NC 1180 C, TIT 7200 LBS/HR, FF (Plus Afterburner Fuel)

Meteorology

Temperature
Bar Pressure
Rel Humidity
Wind — Speed
— Direction

18.3 C 0.699 M Hg 39 % 3.3 M/Sec (6.5 KTS) 210 Deg

RESULTS

Table 2 lists the overall and 1/3 octave band SPL measured at the far-field locations under meteorological conditions at the time of test. Data in all other figures and tables are based on these levels. These data were normalized to 100 meters distance and standard meteorological conditions (15 C temperature, 70% relative humidity, 0.760 meter Hg barometric pressure) and used to derive the graphic data in Figure 2 which provides a compact summary of the far-field noise characteristics of the F-14A aircraft in a standard format.

Figure 3 and Table 3 present two basic acoustic measures, the acoustic power level and the directivity index, respectively. The acoustic power level describes the power radiated by the source as a function of frequency. The directivity index is a standard acoustical engineering measure that describes the geometric way in which the source radiates this power as a function of both frequency and angle from source. These basic source measures are primarily of interest for acoustical engineers and noise generation/control specialists.

Estimates of the noise levels for intermedite power settings (e.g., 85% RPM) and/or different number of engines operating (e.g., single engine) can be determined as explained in Volume 1 of this handbook.

Figures 4 through 10 are sets of equal noise contours describing seven different measures of noise as a function of angle and distance from the source for standard day meteorology. They are respectively, overall sound pressure level, C-weighted sound level, A-weighted sound level, perceived noise level, speech interference level, permissible exposure times for personnel and octave band sound pressure levels.

Data excessively influenced by spurious background/electronic noise were eliminated from all figures and tables. No data are presented at the 180 degree location for the idle power nor at the 170/180 locations for the other power setings because of turbulent air flow behind the aircraft. Typically, the A-weighted levels for these angles are 10 to 20 dBA below the level measured at the preceding micropone location.

Test personnel performed noise surveys during quiet periods when the background noise was minimal, e.g., early in the morning when no other aircraft or engine test stands were operating. Data eliminated because they were near the background/electronics noise were generally not significant because the levels were so low (e.g., Table 2, idle power).

Volume 2 of the handbook describes the influence of meteorology on far-field noise environments, and provides, if required, the factors necessary to adjust the handbook's standard meteorological day data.

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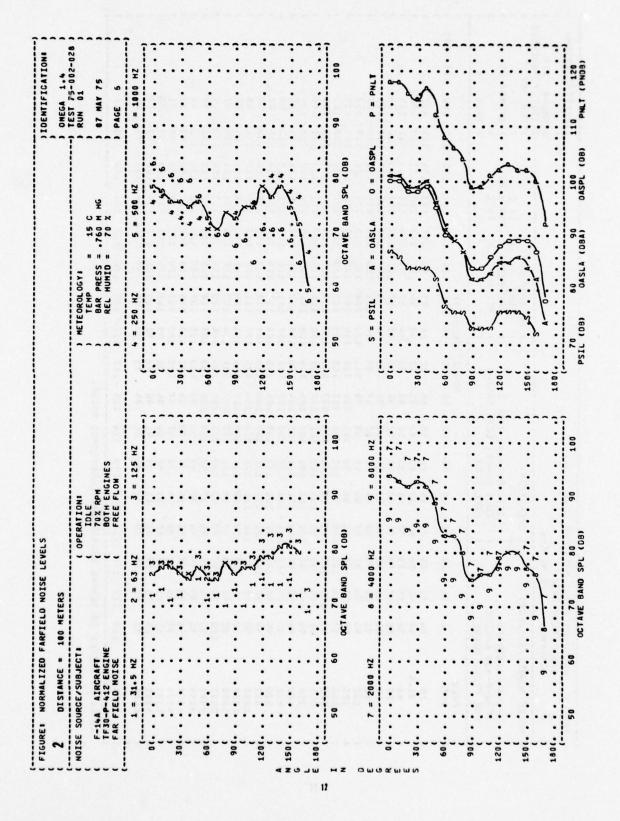
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2500	101	86	96		96	16	92	68	85	80	82		81	80	80	92	78	
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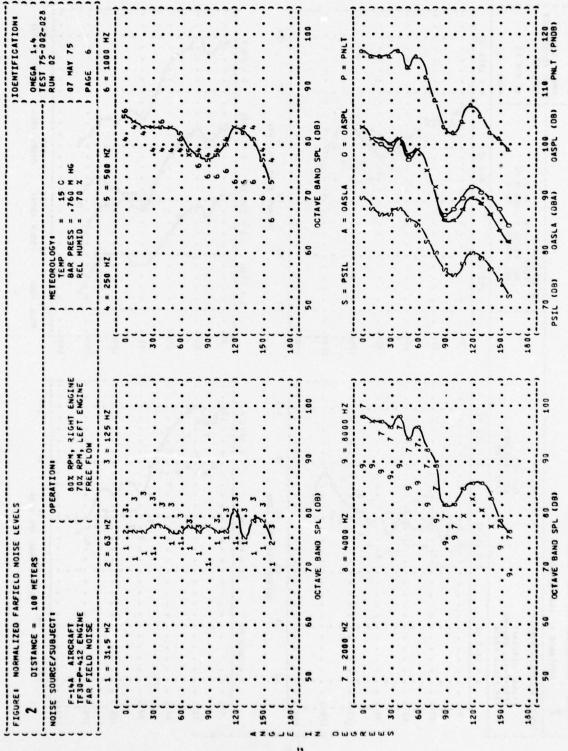
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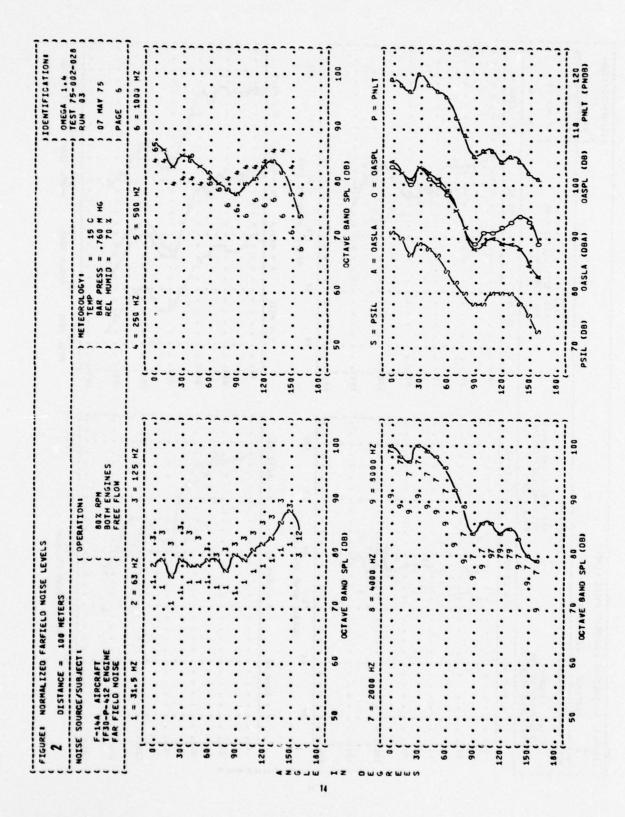
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TF30-P-412 ENGINE	ENGINE			,	OLE P	OWER,	LEFT	IDLE POWER, LEFT ENGINE	¥	-	REL +	UMID	"			-		
FAR FIELD NOISE	NOISE			-	REE	LON				-						-	PAGE	2
FREG								A		(DEGREES)	ES)							
(HZ)	•	10	50	30	04	20	09	20	80	90	100	110	120	130	140	150	160	170 180
25	734	744	764	754	754	754	11	11	80	81	81	80	98	9.0	93	96	96	
31.5	90	62	19	78	19	80	62	82	82	82	84	84	88	98	66	100	86	
04	80	80	61	80	81	82	82	85	98	96	88	89	92	98	104	107	101	
20	81	80	9.0	80	82	82	82	94	95	98	18	68	62	101	106	107	102	
63	81	81	83	83	83	9.4	98	98	87	68	91	76	100	105	110	110	102	
80	48	84	85	94	95	98	87	88	68	95	16	96	102	109	114	113	105	
100	68	68	90	90	90	91	90	95	93	96	16	100	106	115	119	118	106	
125	68	90	91	91	91	91	95	93	16	26	96	101	107	116	121	120	105	
160	95	93	76	93	36	93	93	16	95	98	100	104	109	115	123	121	105	
200	93	46	96	93	93	93	96	96	96	98	101	105	110	115	119	121	106	
250	*6	46	95	93	46	16	96	96	26	66	102	105	112	117	118	121	103	
315	96	95	16	16	96	95	96	96	26	100	102	106	110	118	120	111	100	
004	95	76	93	95	96	46	96	96	26	98	102	106	111	115	118	115	26	
200	95	93	46	95	96	95	96	96	26	66	102	105	110	114	115	113	95	
630	91	93	56	95	96	62	96	96	26	96	102	105	108	112	113	109	85	
800	68	91	93	96	96	96	16	95	96	98	100	103	106	108	109	105	82	
1000	88	90	93	46	76	16	93	95	35	26	66	101	103	105	107	101	80	
1250	87	89	95	35	26	93	93	*6	95	96	26	98	100	103	104	100	13	
1600	88	89	91	95	35	93	85	16	16	96	98	98	100	103	103	102	11	
2000	96	*6	35	91	26	95	35	93	93	95	86	66	100	102	102	101	7.4	
2500	87	88	89	89	9.0	90	90	95	91	46	86	100	100	101	101	86	73	
3150	85	96	88	88	89	68	90	91	06	93	96	66	66	100	100	96	72	
0004	85	98	98	87	88	88	88	06	68	95	16	26	16	98	98	95	11	
2000	82	83	92	85	90	96	87	68	88	91	93	76	95	95	96	93	20	
6300	7.8	79	81	81	82	82	83	65	85	88	90	95	95	95	95	91	99	
8000	73	75	11	11	18	7.8	62	81	80	84	92	88	88	88	68	88	69	
10000	99	69	7.1	12	73	73	14	22	92	62	81	84	94	85	87	8	69	

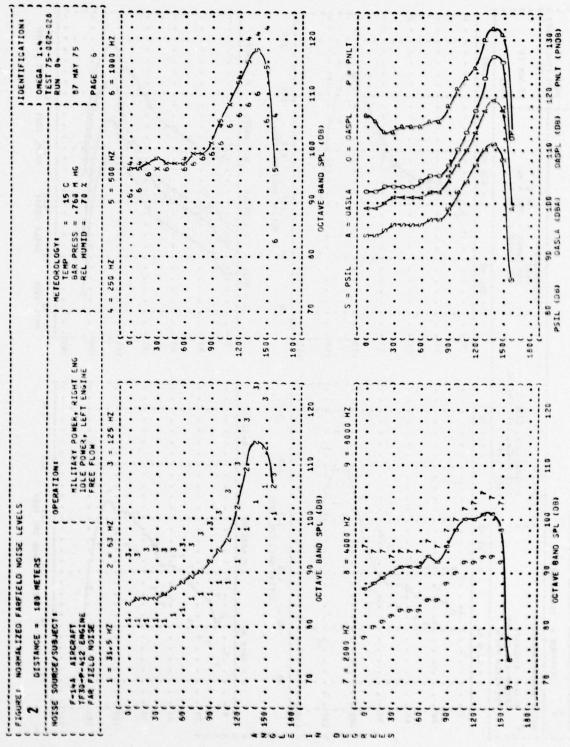
< LEVEL CORRECTED TO REMOVE BACKGROUND/ELECTRONIC NOISE.

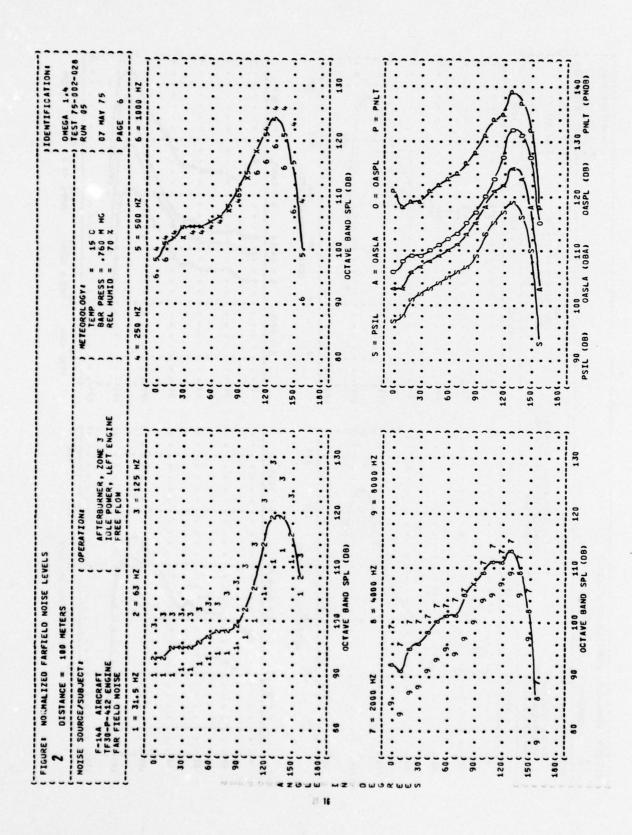
7	1/3 OCTAVE DISTANCE =	E A	BAND 75	METERS	RS												•	ONEGA		- 5
NOISE SOUR	SOURCE/SUBJECT	JECT	-		0	OPERATIONS	* NO					ETEOR	METEOROLOGY					RUN	05	870-2
F-14A A	AIRCRAFT	-				AFTER	BURNE		NE 3			BAR	PRESS	, ,,	H 669	H	•	OZ MAY	17 75	
TF30-P-412 ENGINE FAR FIELD NOISE	D NOIS	INE				IOLE	IDLE PONER, FREE FLOW		LEFT ENGINE	INE		REL	HUMID	n				PAGE	~	
FREG		-	-			-			A	ANGLE	(OEGREES)	EES)								
(ZH)			10	50	30	0 4	20	60	7.0	80	96	100	110	120	130	140	150	160	170	180
52	80	*	84	*8	85	9.4	98	88	88	87	88	89	92	16		104				
31.5	•		88	98	89	68	68	26	91	95	93	96	46	102		110				
04	S		68	68	90	91	95	92	93	93	76	96	66	106		113				
20	•		28	89	91	90	91	95	96	93	93	16	101	105		113				
63	9		91	92	92	93	76	66	95	96	96	86	103	110		111				
000	Jr (35	25	50	*	200	26	26	16	66	102	106	114		116				
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160	. 0			100	100	66	101	101	103	105	106	109	113	120		125				
200	5			101	100	66	101	102	103	105	106	110	115	119		125				
250	5			66	66	100	100	102	102	105	106	110	115	119		123				
315	5			66	100	101	101	103	104	105	108	111	116	120		122				
004	0	62		66	100	101	101	103	104	106	108	112	116	120		121				
200	5			100	101	101	102	103	103	106	108	111	116	119		119				
630	o			101	105	105	102	103	104	106	108	112	115	117		117				
800	3,			100	101	102	105	103	104	105	108	112	113	115		114				
1000	31			66	100	101	102	103	104	105	107	111	111	113		112		88		
1250	J• 1			66	66	100	101	102	103	105	106	109	110	111		111				
1600	31			96	66	66	101	102	103	104	104	109	112	111		111				
2000	100			26	46	96	100	101	101	103	104	109	111	111		110				
2500	5		91	95	96	16	66	100	100	103	105	108	110	110		108				
3150	5		89	16	76	26	66	66	66	103	105	107	109	109		106		84		
0004	o		88	95	93	96	16	66	98	102	103	106	108	107		106				
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OVERALL	108		110	111	112	112	113	114	115	117	119	122	126	129	134	133	129	117		

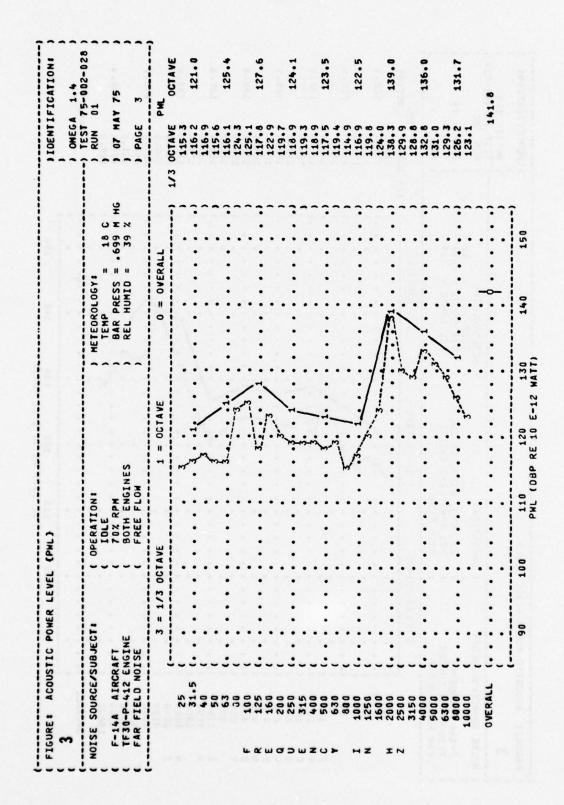


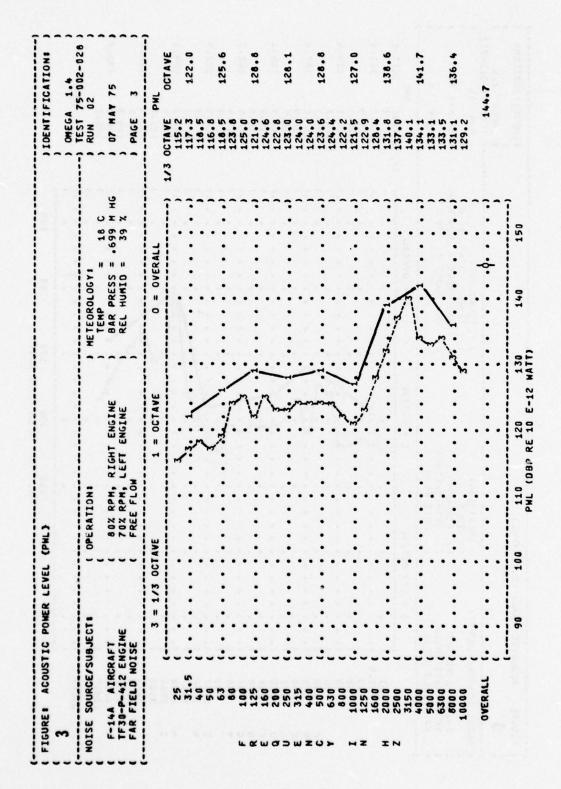




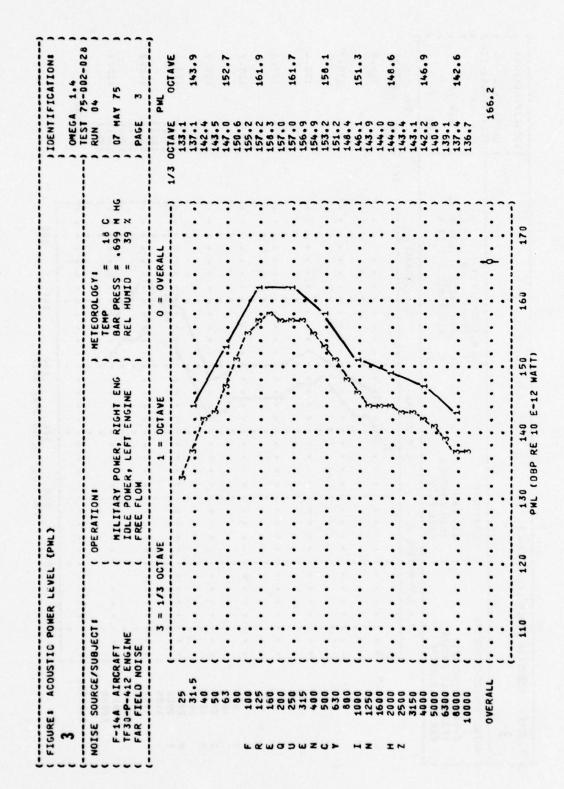


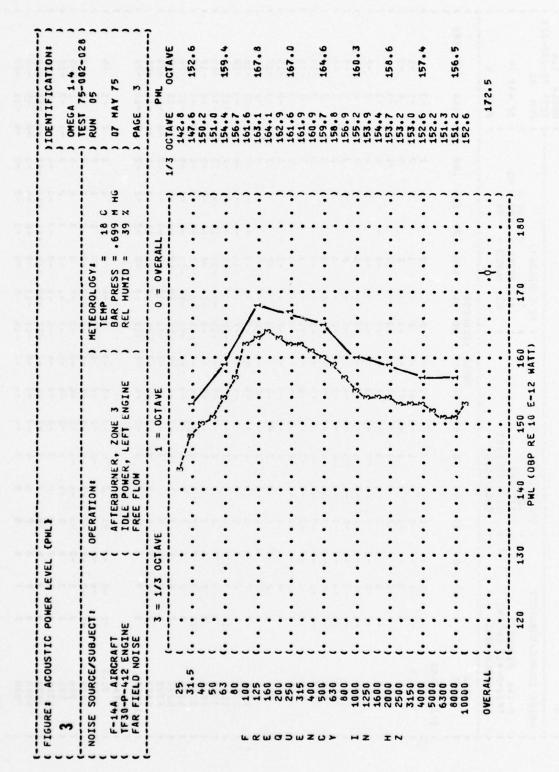






•					ONEGA 1.4
NOISE SOURCE/SUBJECT	SUBJECT	(OPERATION!) METEOROLOGY:) RUN 03
F-14A AIRCRAFT	RAFT	C 80% RPH	2	PRESS = .699	1 07 HAY 75
FAR FIELD NOISE	OISE	(FREE FLOW) PAGE 3
	3 = 1/3	3 OCTAVE	1 = OCTAVE	0 = OVERALL	PHL
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200					124.7 129.7
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1600		•			
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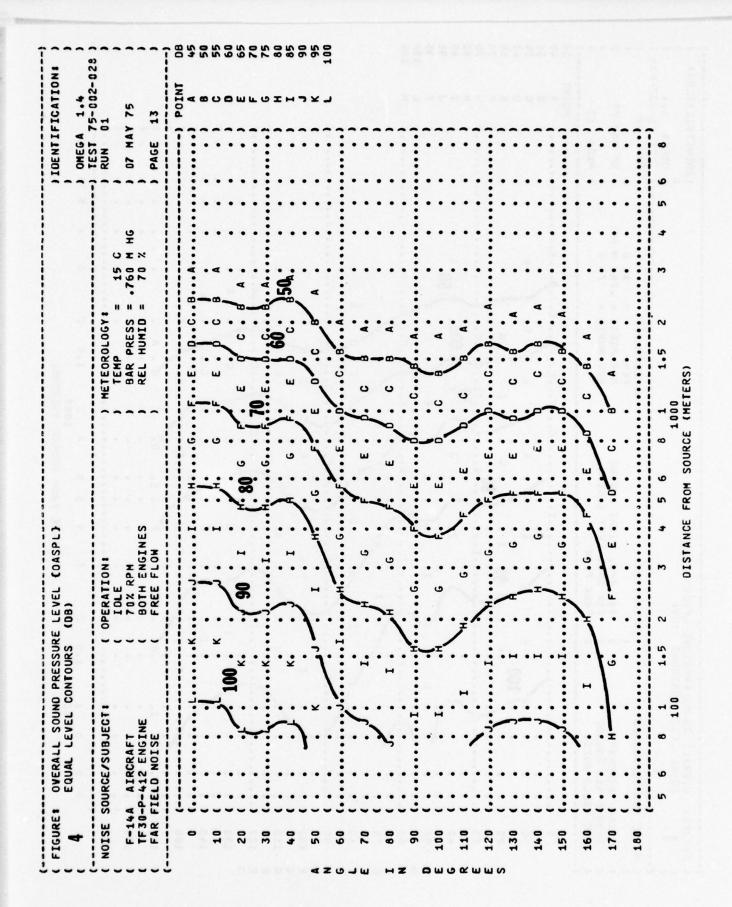
																•	ONE	A 1.4	
		-	-				-			-	-			-	-		TEST	15-0	2-028
NOISE SOURCE	SOURCE/SUBJECT			OPE	ERATION	. NO				Ī	METEOROLOGY:	OF 06 Y	_ '				RUN	01	
F-14A AIR	KRAFT				70% R	W				• •	BAR	PRESS	9	0 66	9	•	M 20	MAY 75	
TF30-P-412 ENGINE	ENGINE				BOTH ENGINES	ENGIN	ES				REL	HUMID		39		-			
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FREQ	•	10	20	30	0,	20	9	70 A	ANGLE 80	OEGREE 90 1	100	110	120	130	140	150	160	170	180
1/3 OCTAVE																			
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0,	-	0	7	7	8	•	-2	7	-3	7	-5	0	2	~	0	2	•		
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99	7			m 1		0	2	;	;	;	.	7	7	~	-		-	•	
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2000	6	6		9	7	2	-2	-5	-1	-13	-14	-11	-12	-11	-11	-10		-19	
2500	80	1		1	9	2	-2	2-	1	6-	-12	80	9-		9-				
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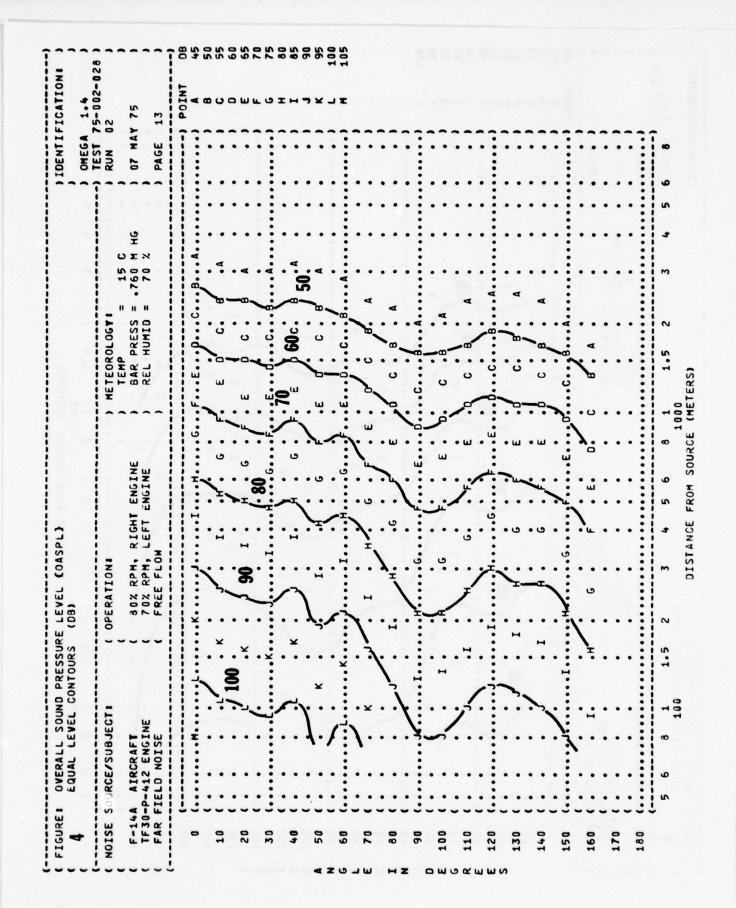
,																- 1	OMEGA	75-082-825	-
NOISE SOURCE.	SOURCE/SUBJECT	11:	-	00	OPERATION	INC		-		-	METEOROLOGY	100 Y				-	RUN	02	
	1000						100	Sur Tue			TEMP	0000		0 1	,		24 40	36	
TF30-P-412 ENGINE	412 ENGINE				70% 8	RPH,	LEFT E	ENGINE			REL	HUMID		39 %	2		20	1 12	
FAR FIELD NOISE	NOISE			J	FREE	FLOM				-						^	PAGE	,	
FREQ			-					Ā		(DEGREES)	ES)								
(HZ)	•	10	50	30	0+	20	09	7.0	9.0	90	100	110	120	130	140	150	160	170	180
1/3 OCTAVE																			
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3150	9	5	5	0	9	2	2	1	-3	-11	-12	-10	-1	-1	-11	-14	-14		
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OVERALL	*	4	u		•														

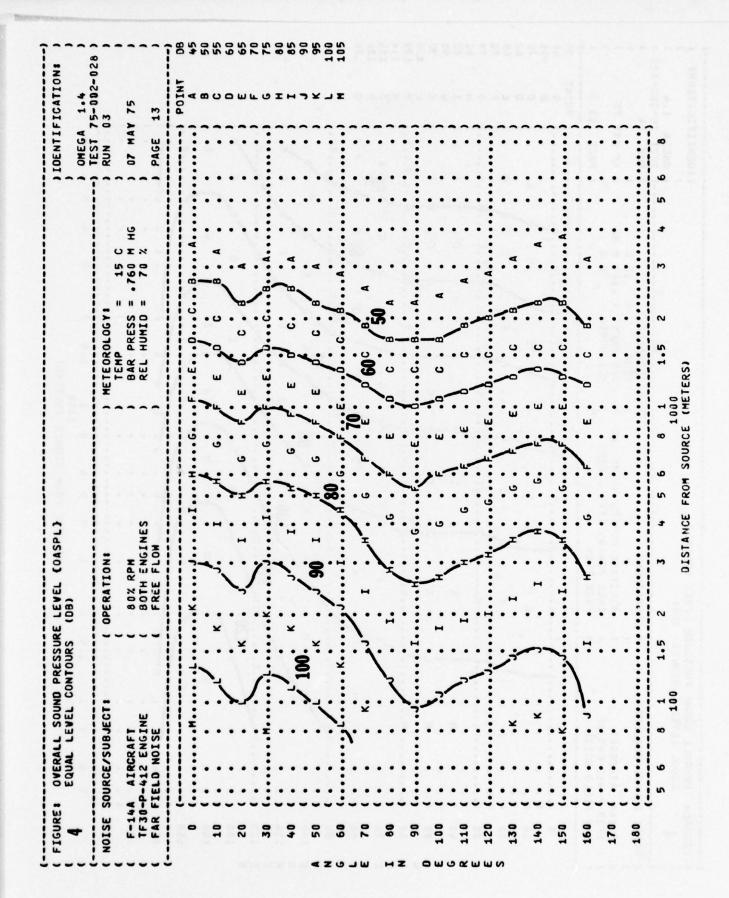
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NOTSE SOURCE	SOURCE/SUBJECT	1:		90	OPFRATIONS	8 NO				-	ETFOR	01 06 Y	-			1	TEST 7	75-002-0	2-028
				_						-	TEMP	-	,,	18 C		-			
F-14A AIRCRAFT TF30-P-412 ENGINE	ENGINE NOTSF				80% R 80TH FRFF	807H ENGINES	ES				BAR	BAR PRESS REL HUMID	9. "	2 6 6 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8	9		OF MAY	12	
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1/3 OCTAVE																			
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2000	6	9	r.	1	S	t	2	-2	-5	9	-8	9-	-1	9-	6-	-11	-14		
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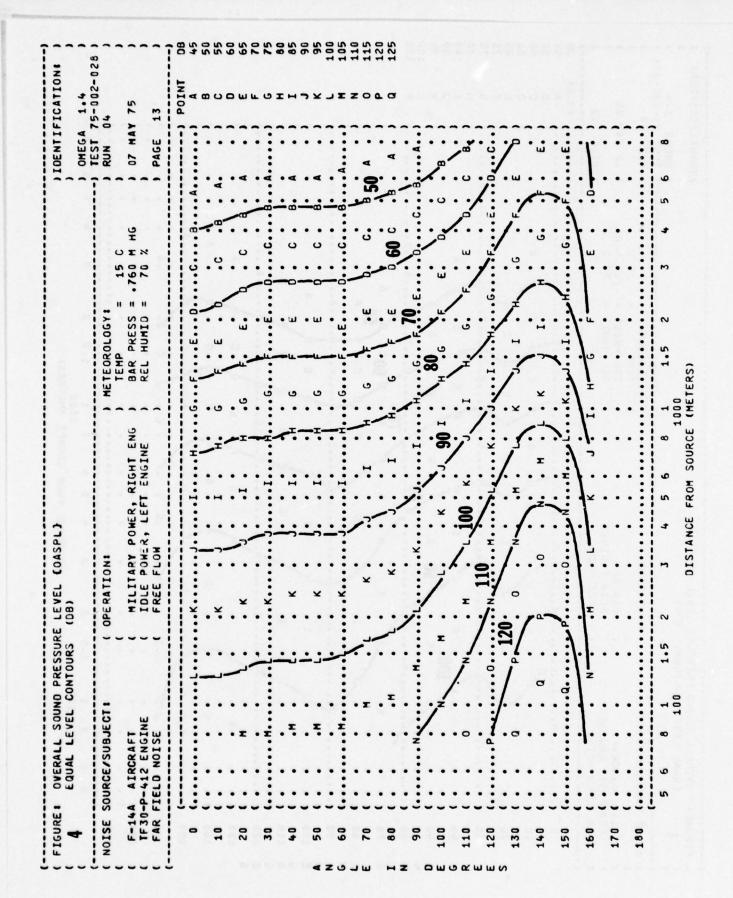
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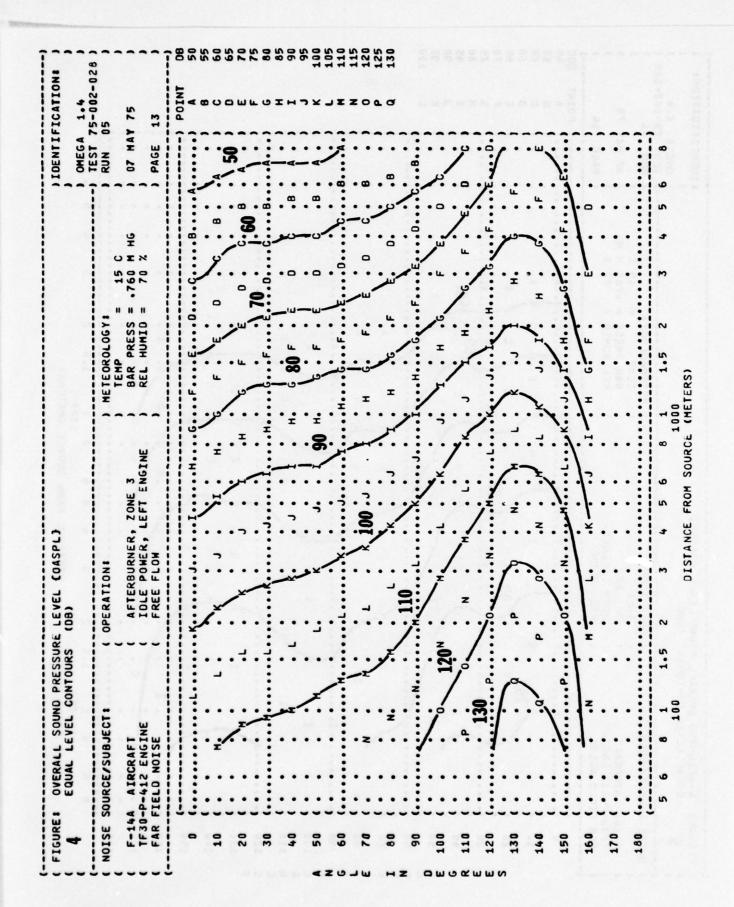
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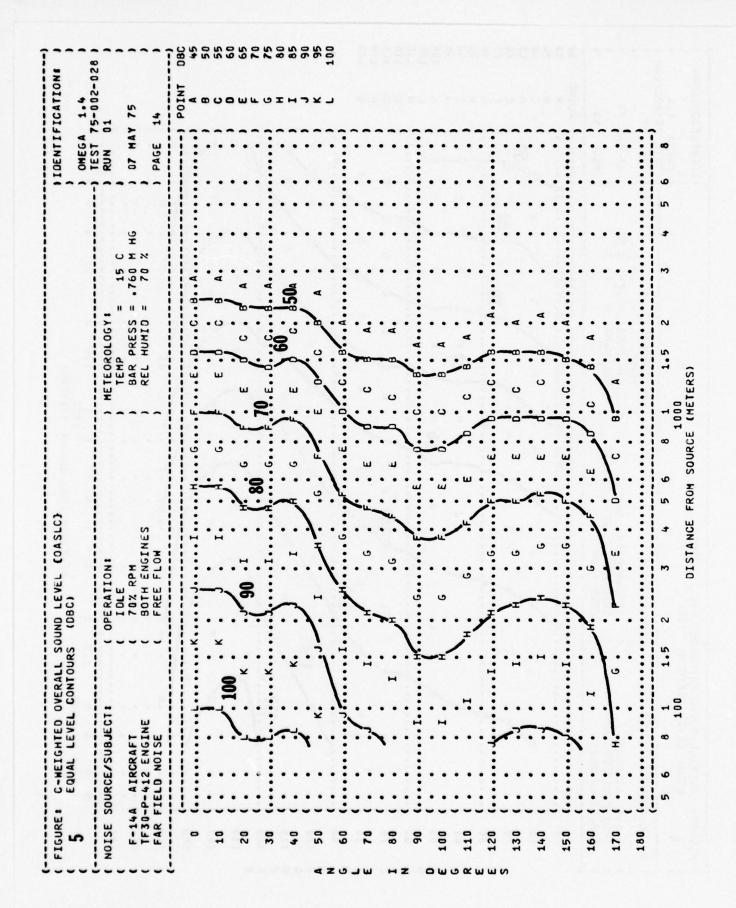


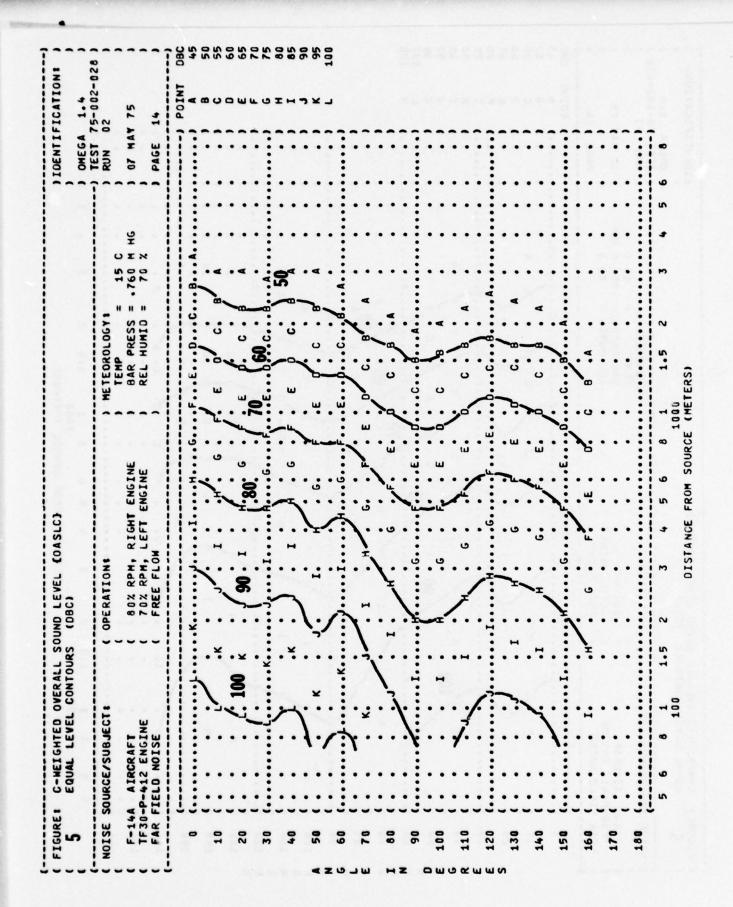


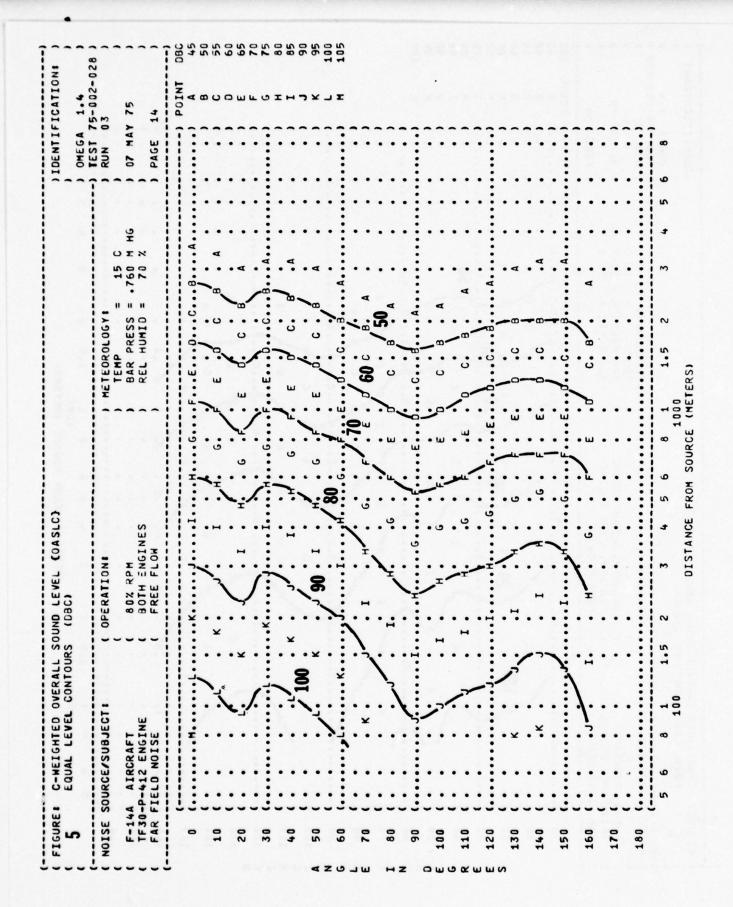


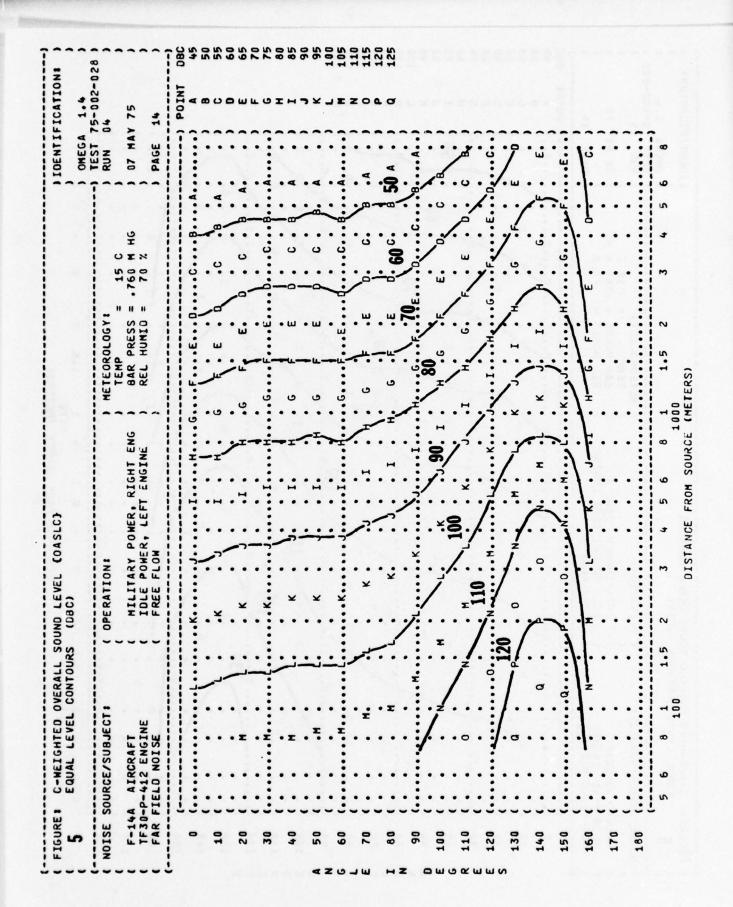


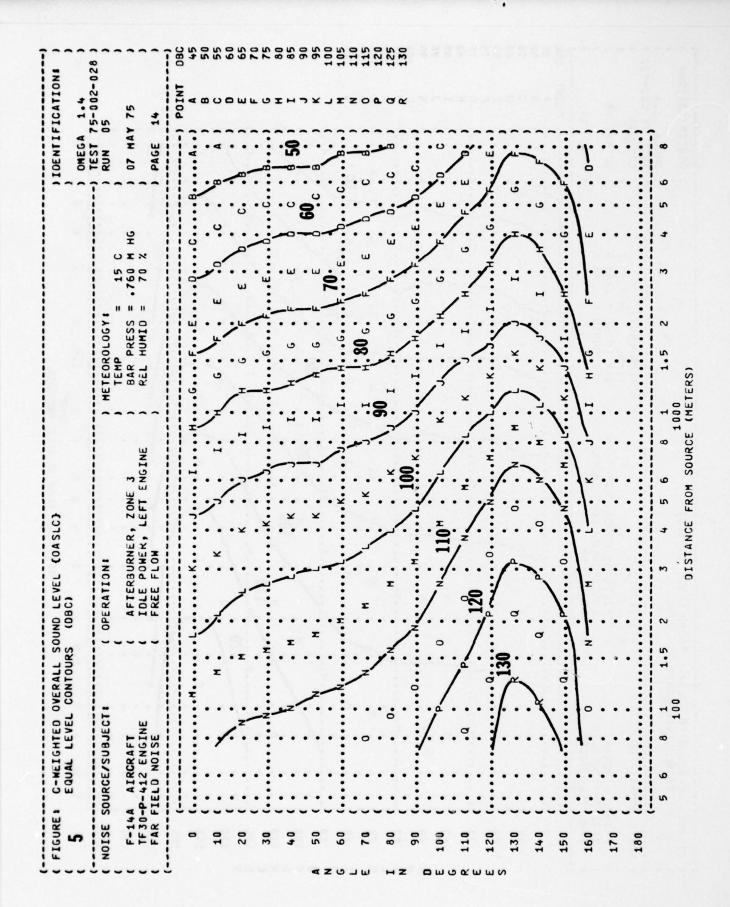


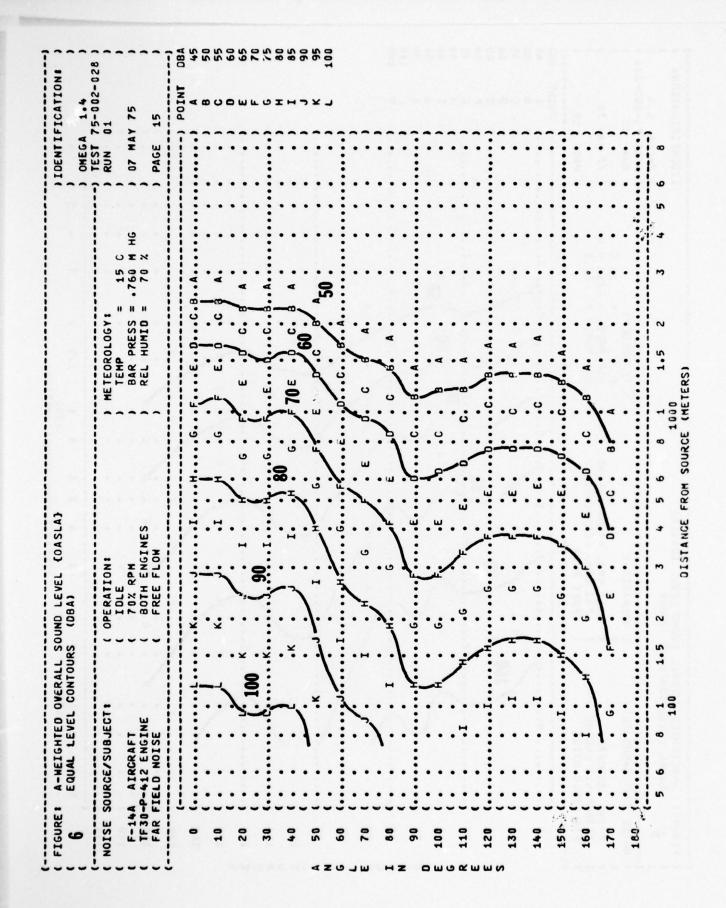


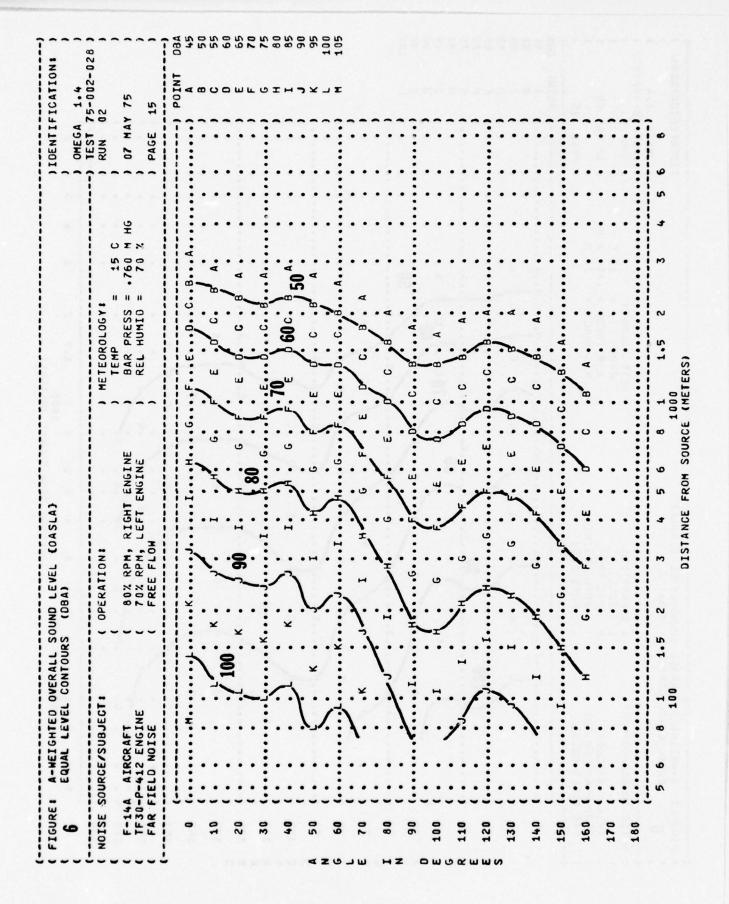


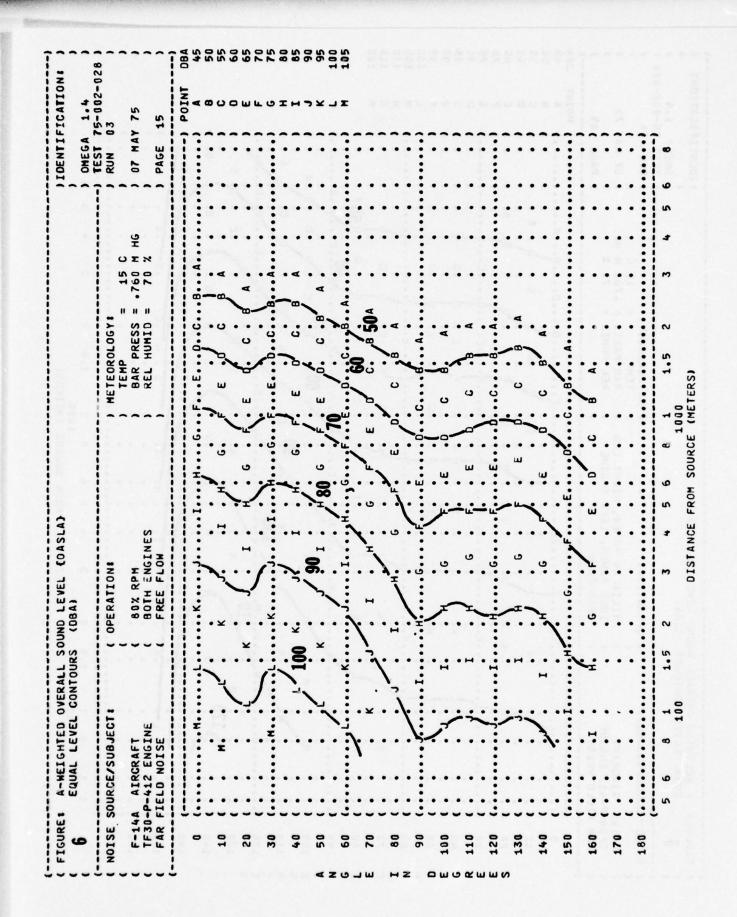


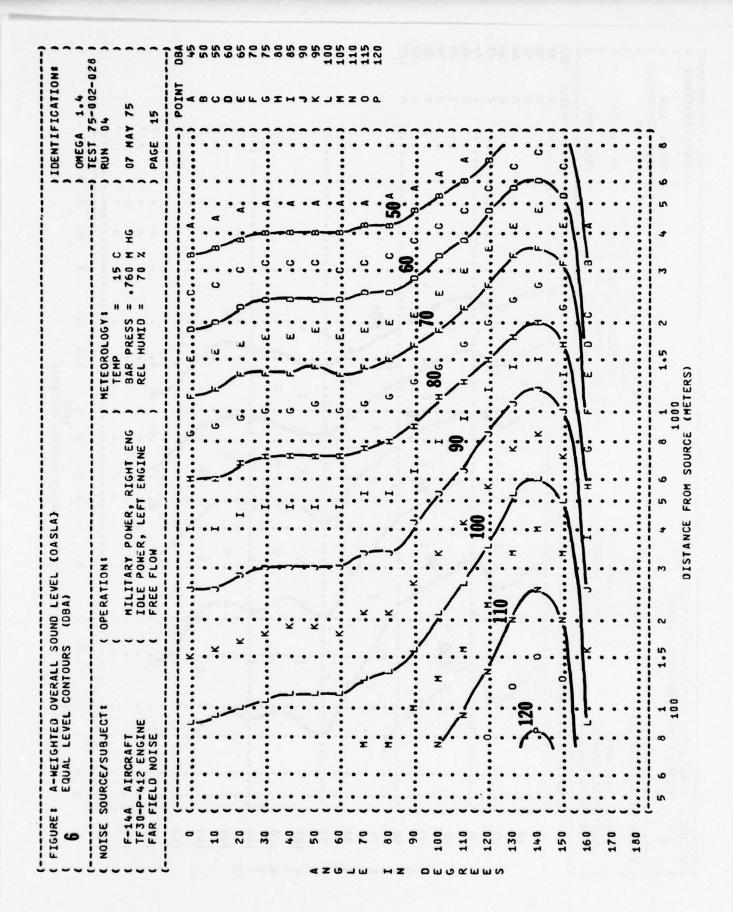


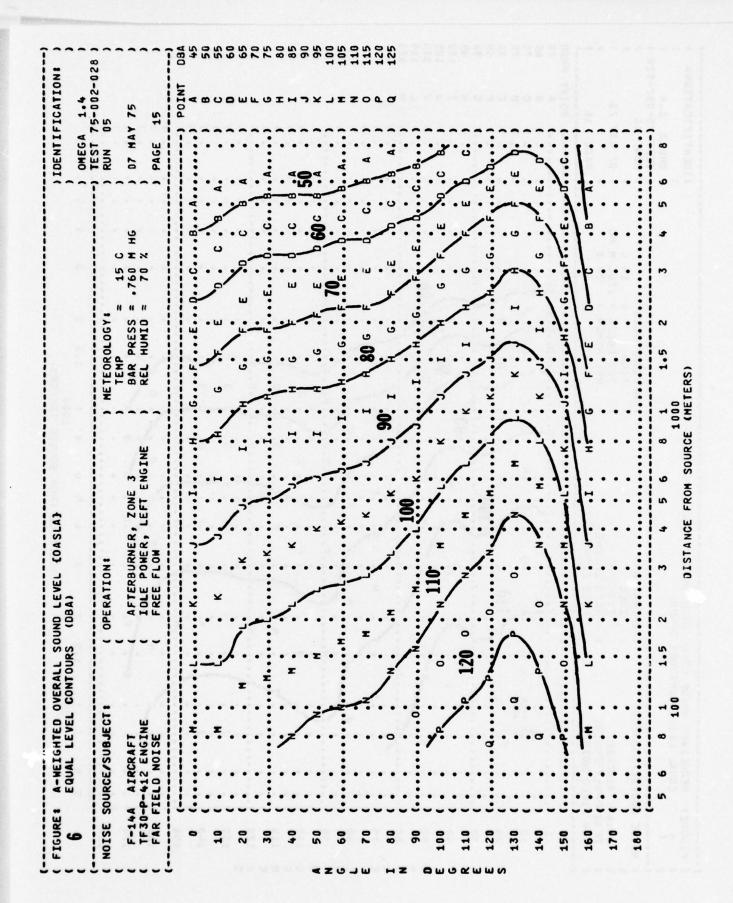


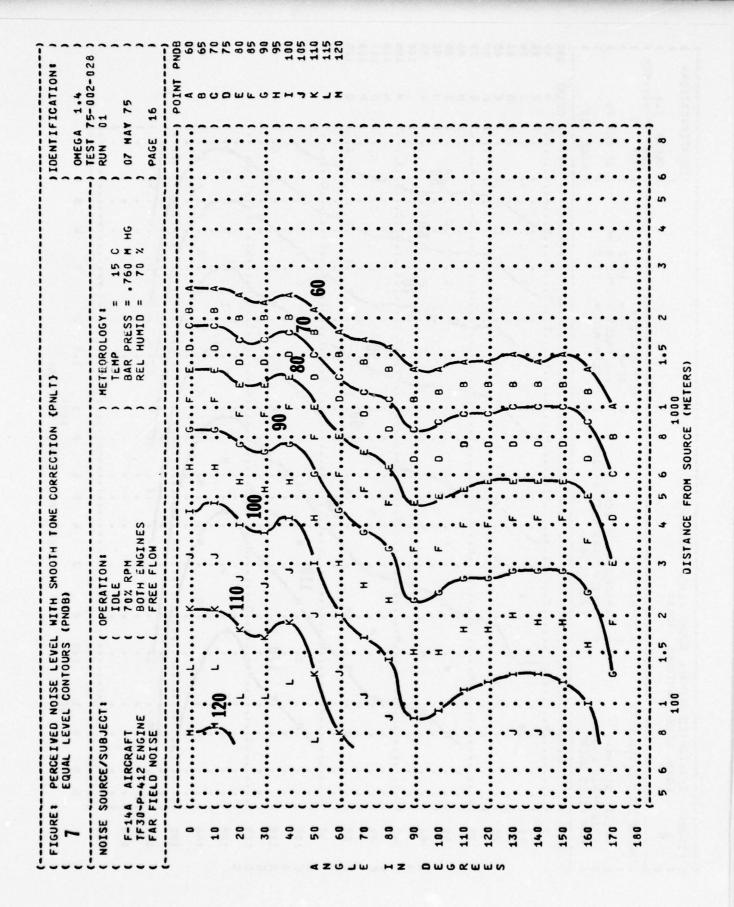


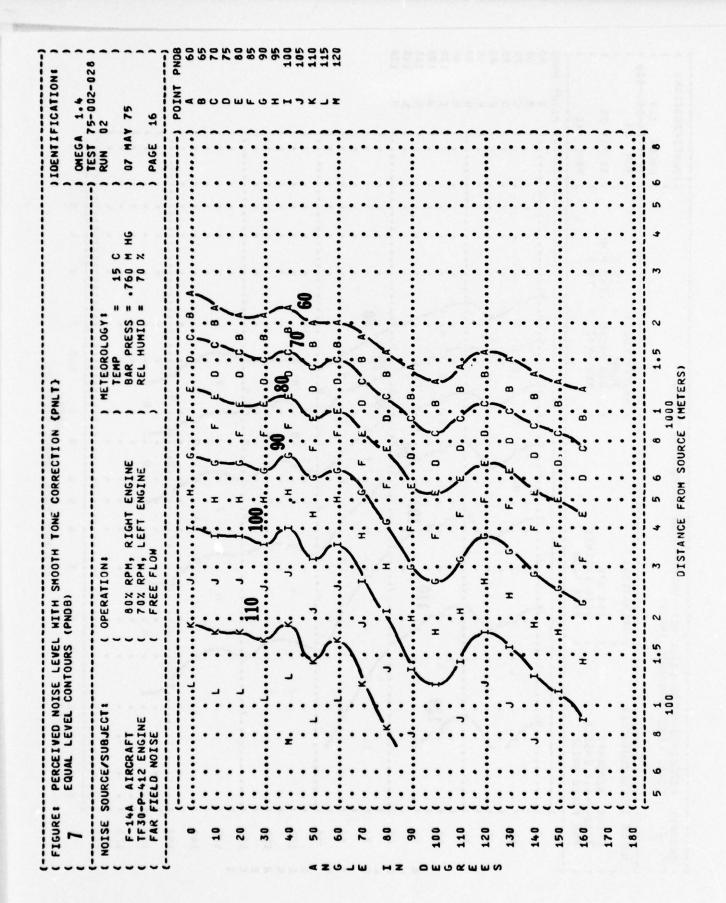




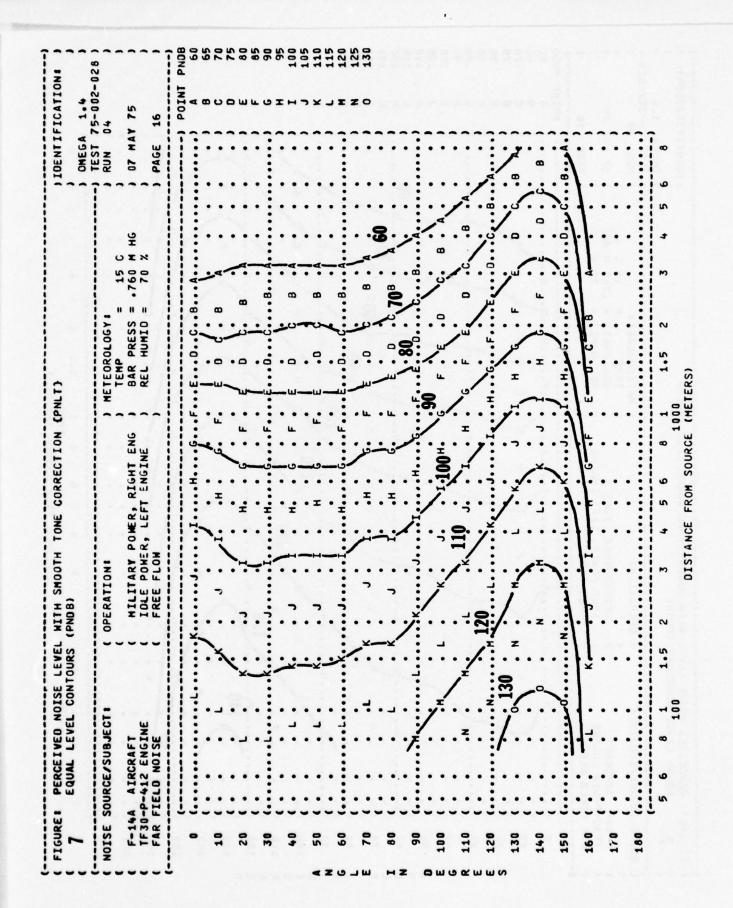


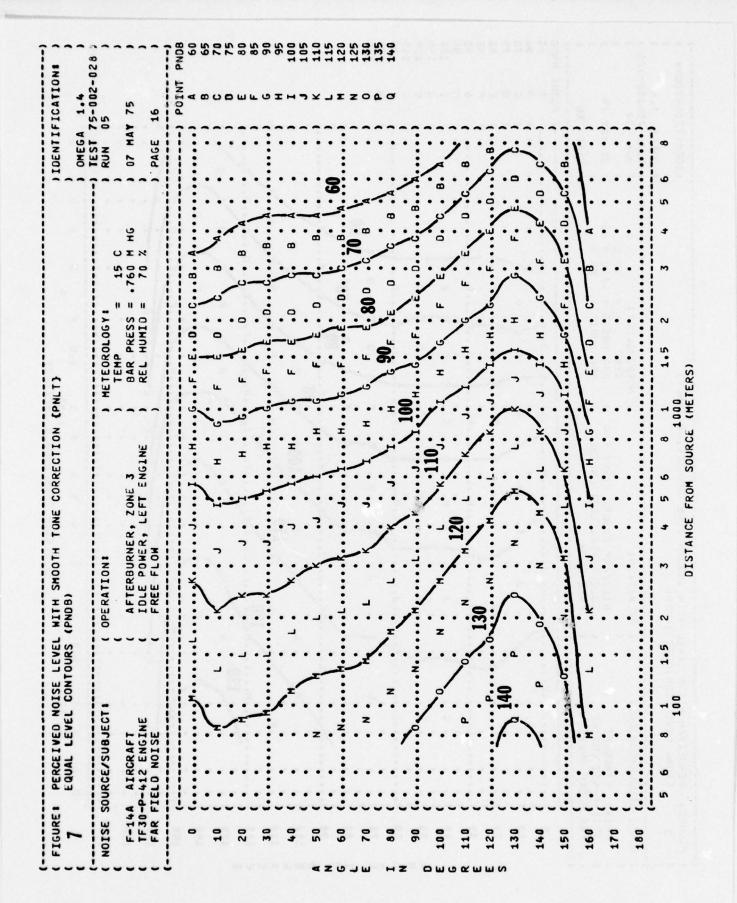


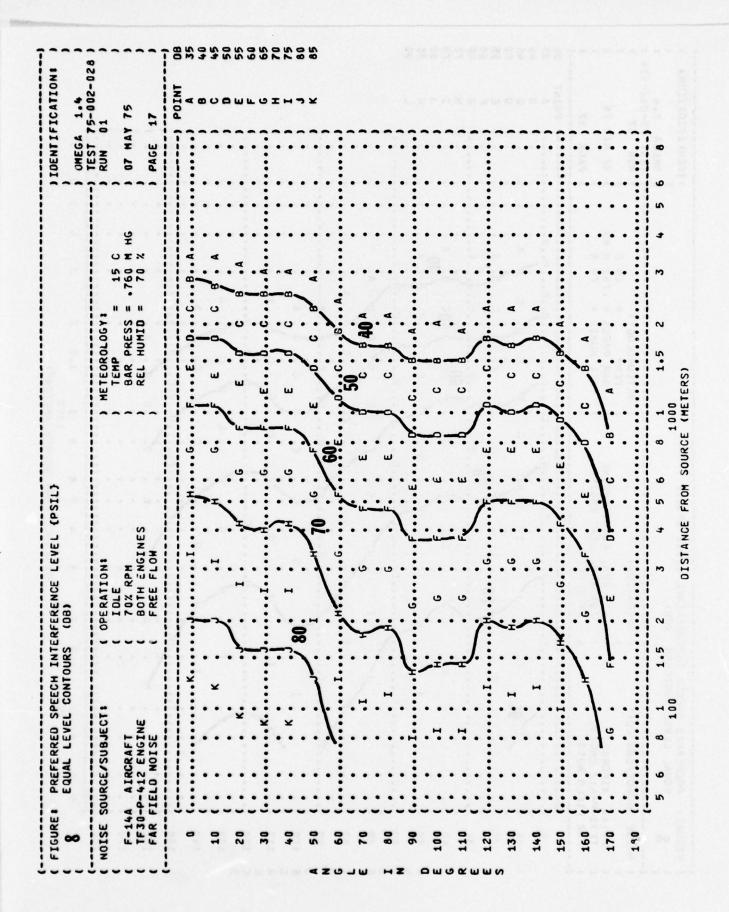


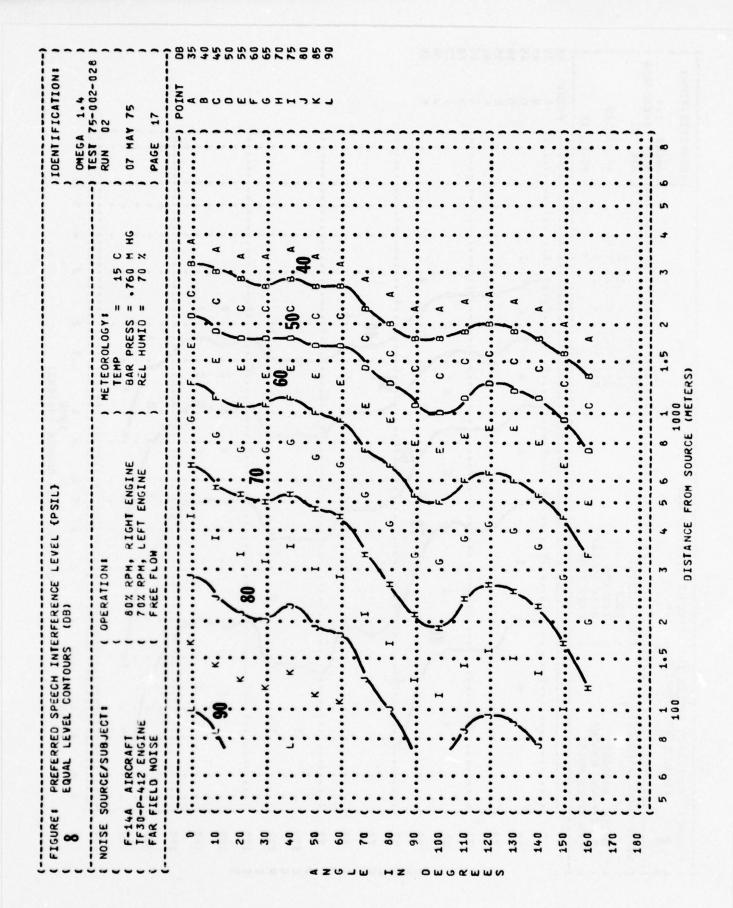


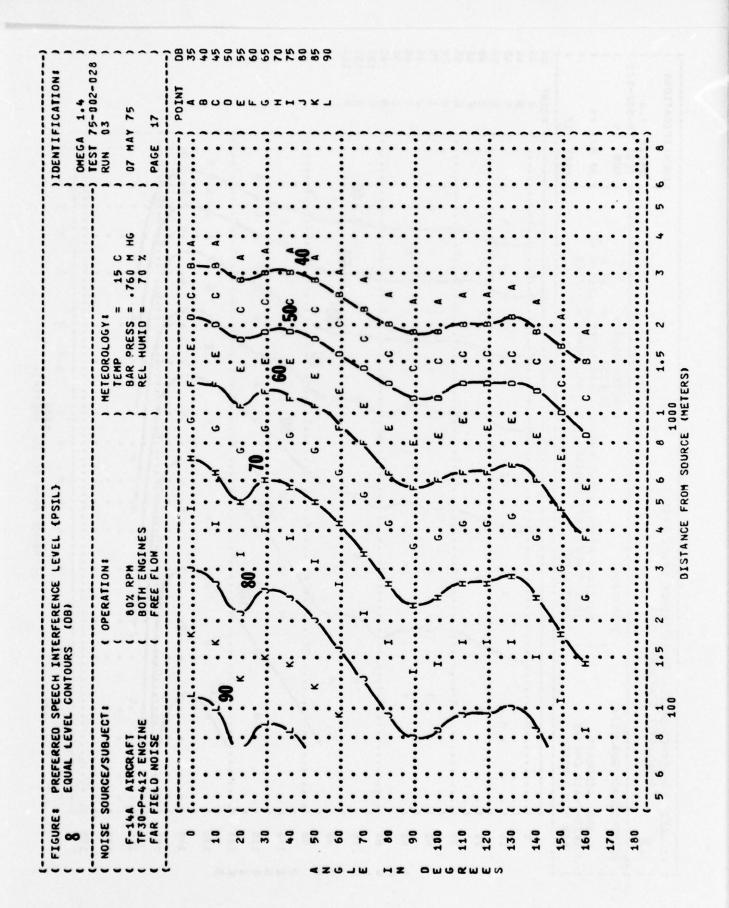
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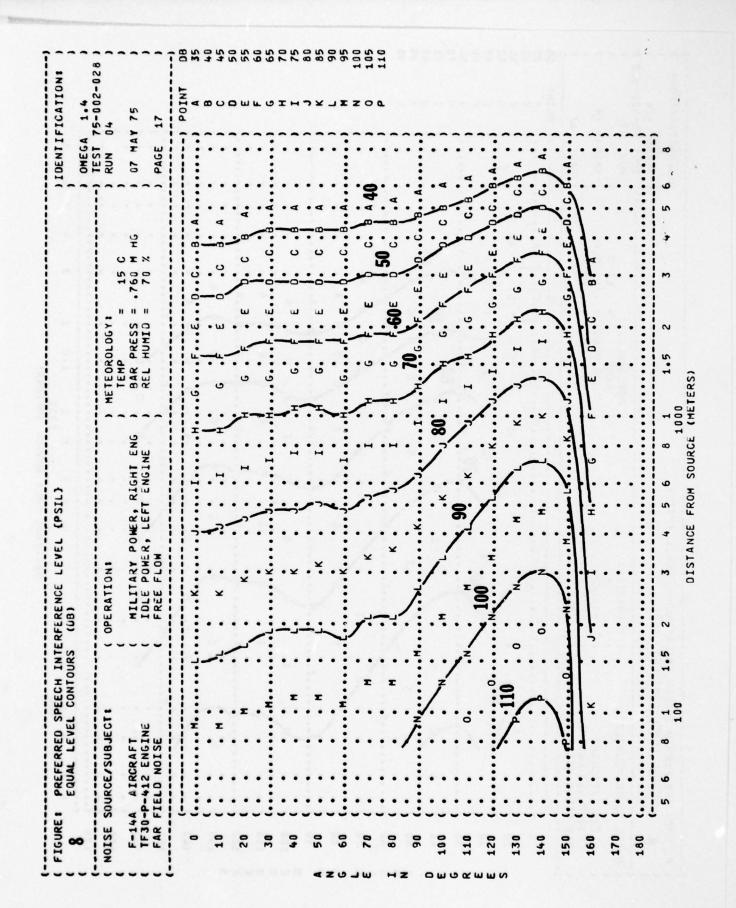


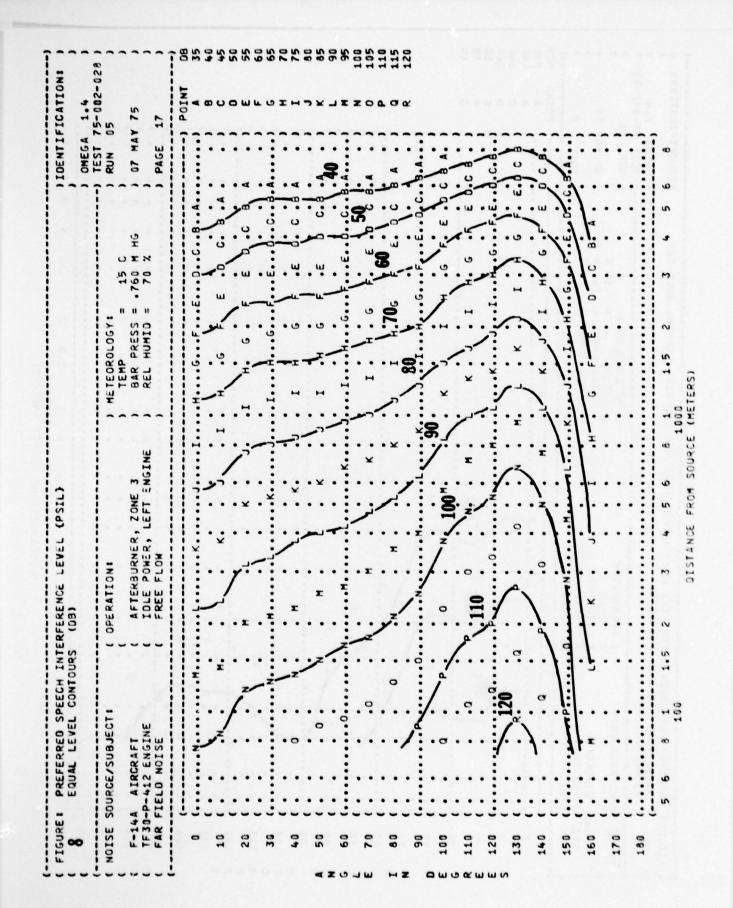












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>06		AMERICAN OPTICAL 1700 EAR HUFFS	
100		V-51R EAR PLUGS	•
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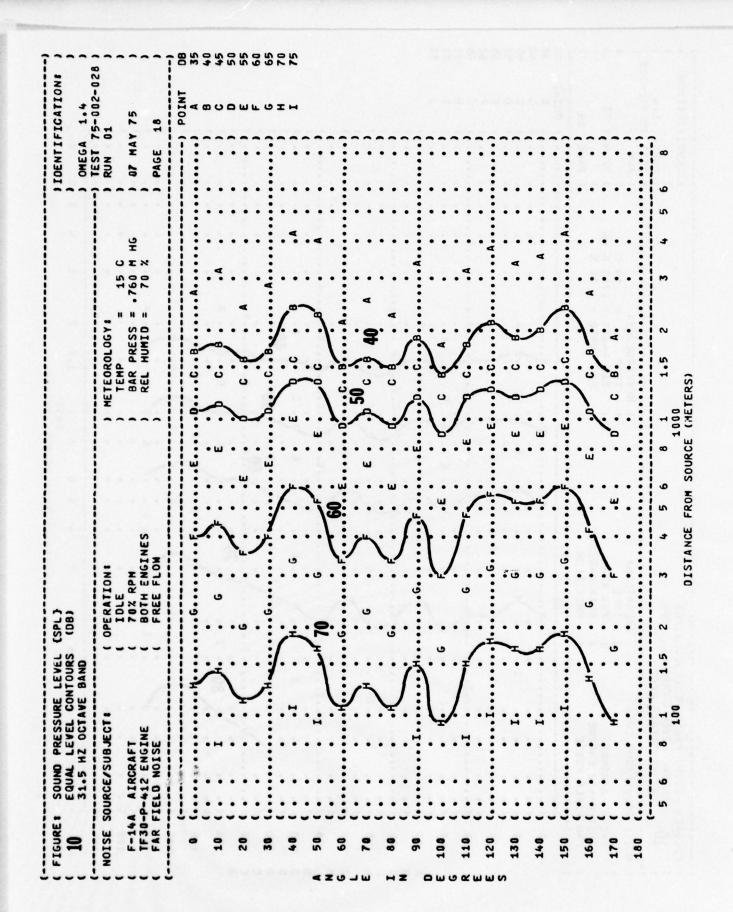
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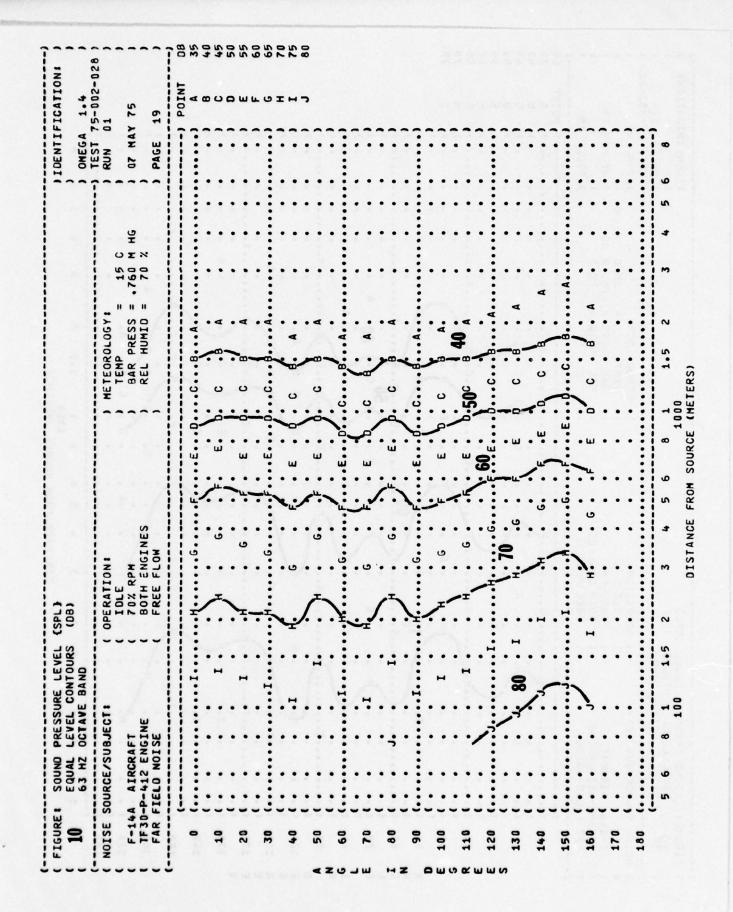
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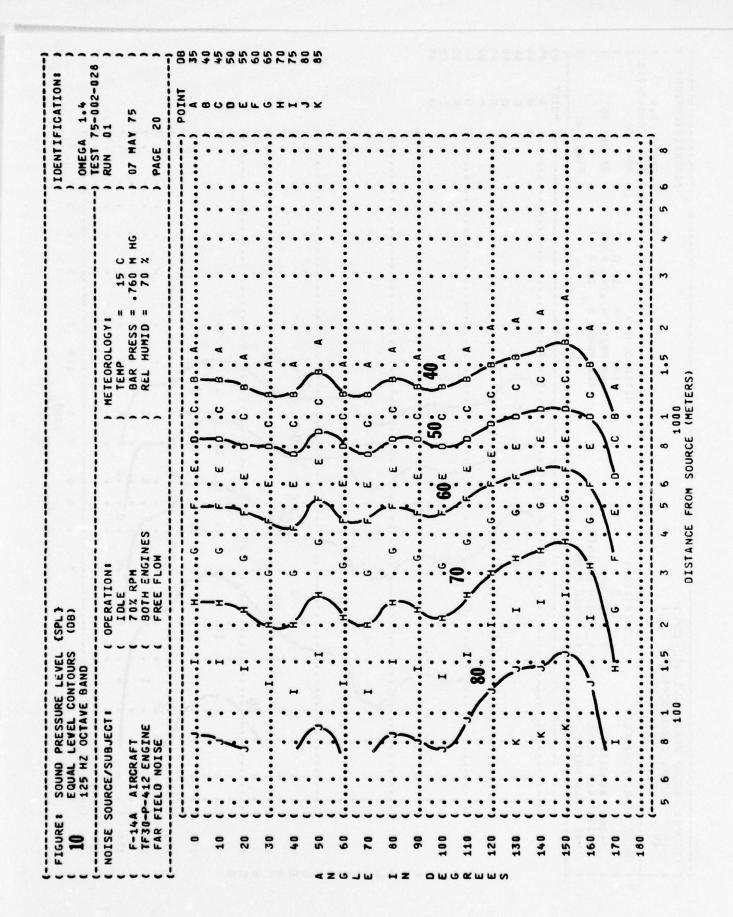
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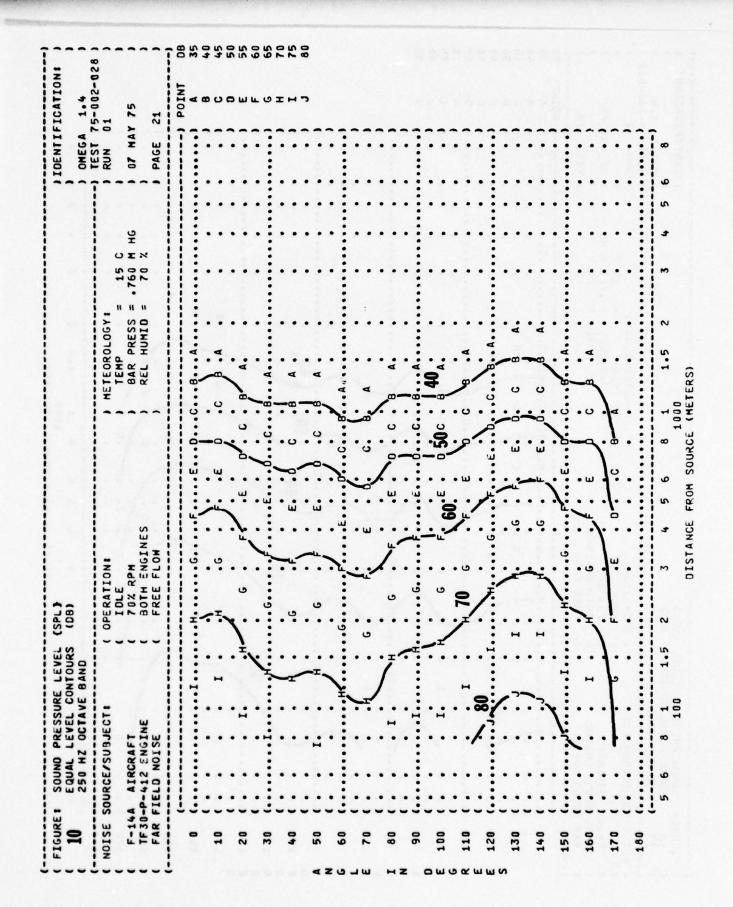
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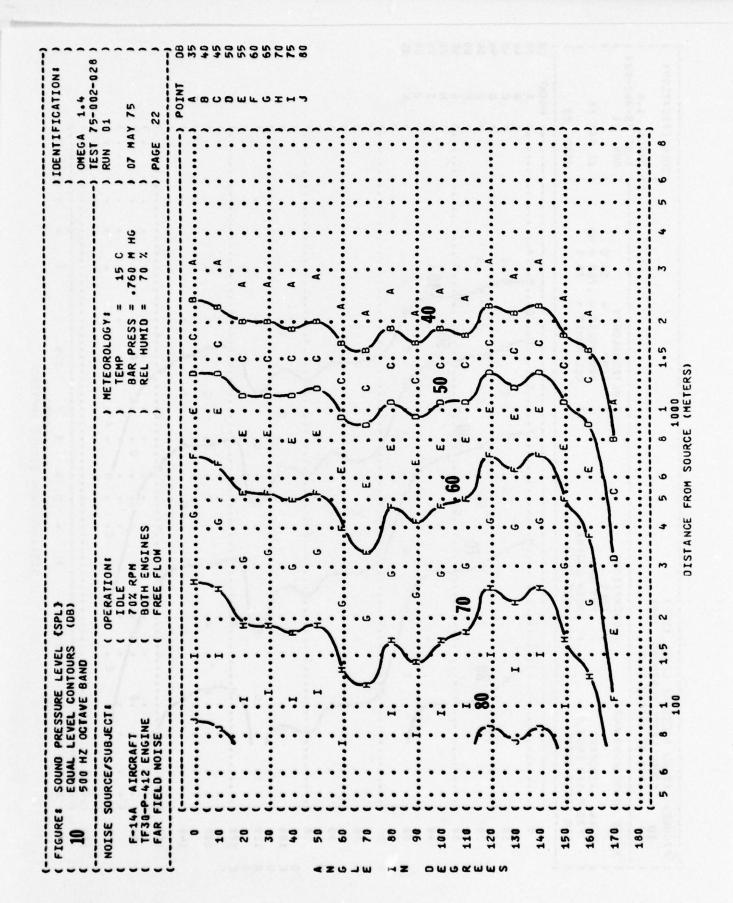
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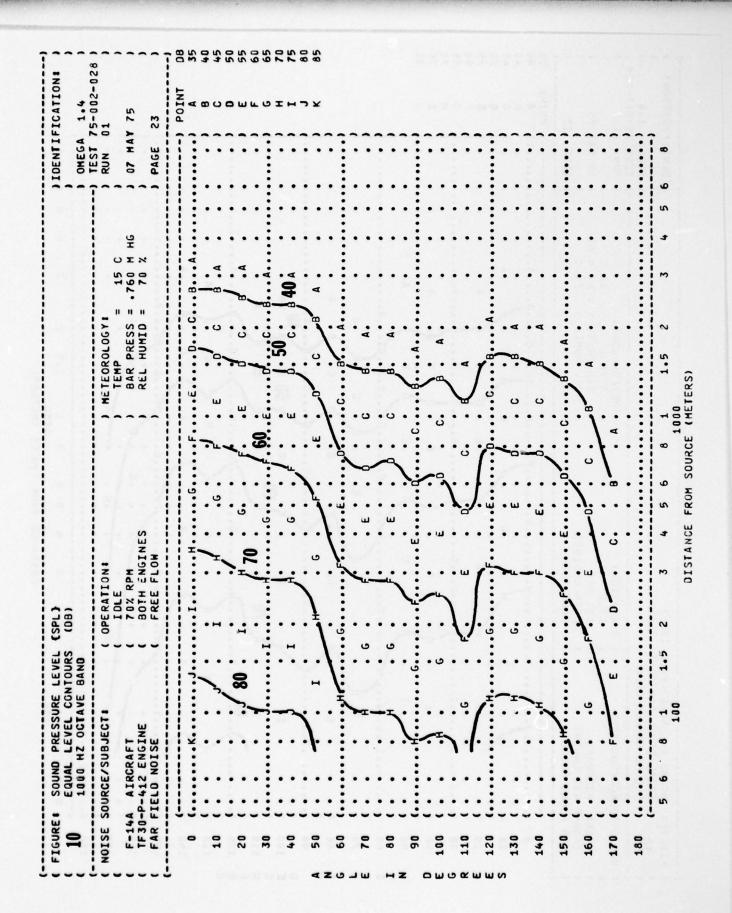


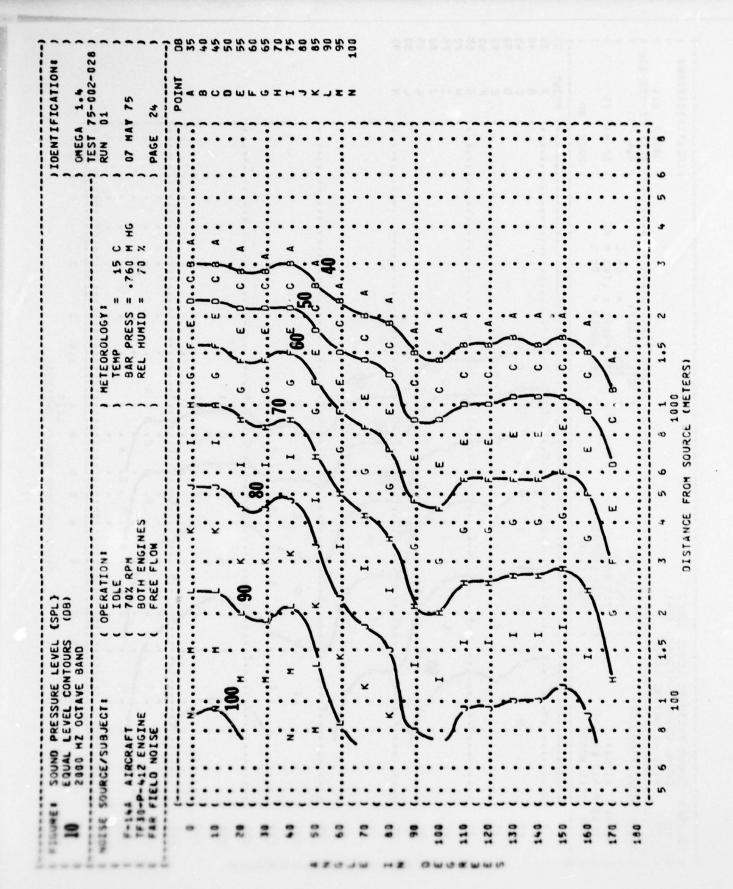






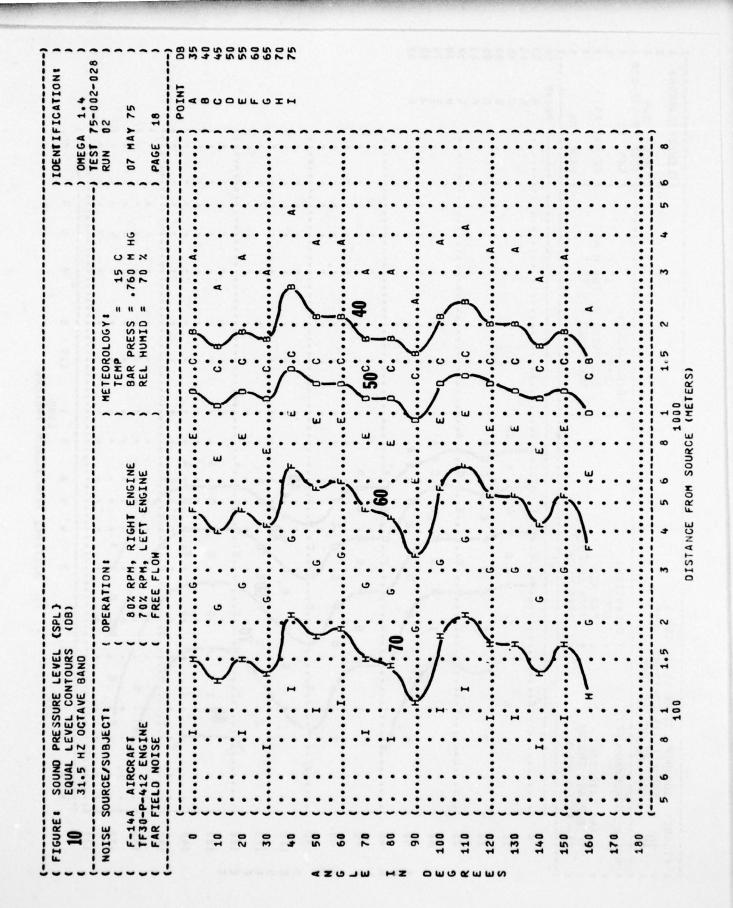




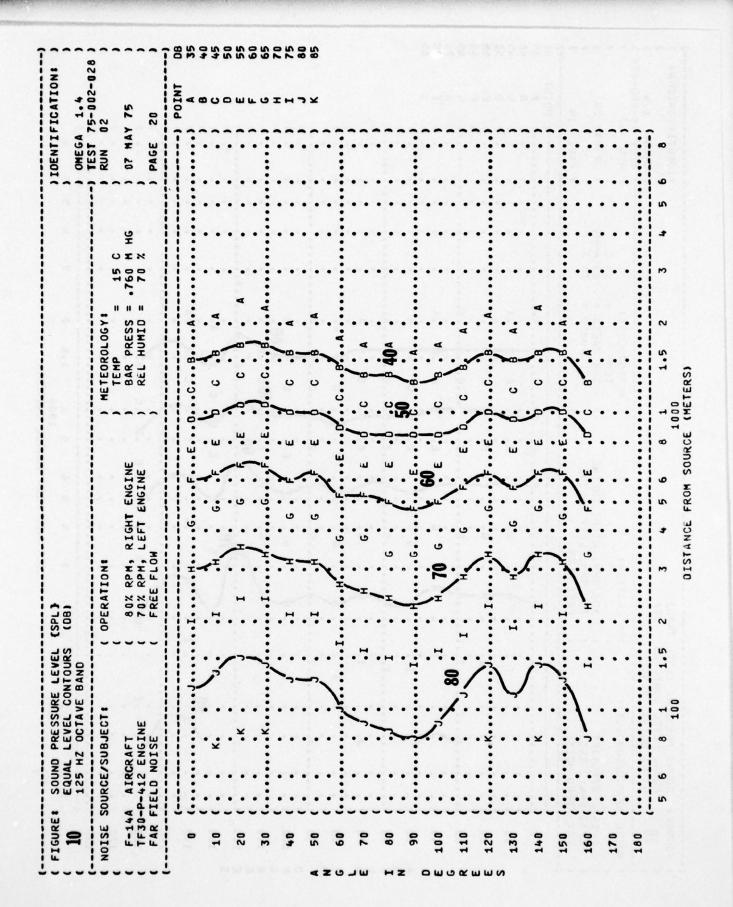


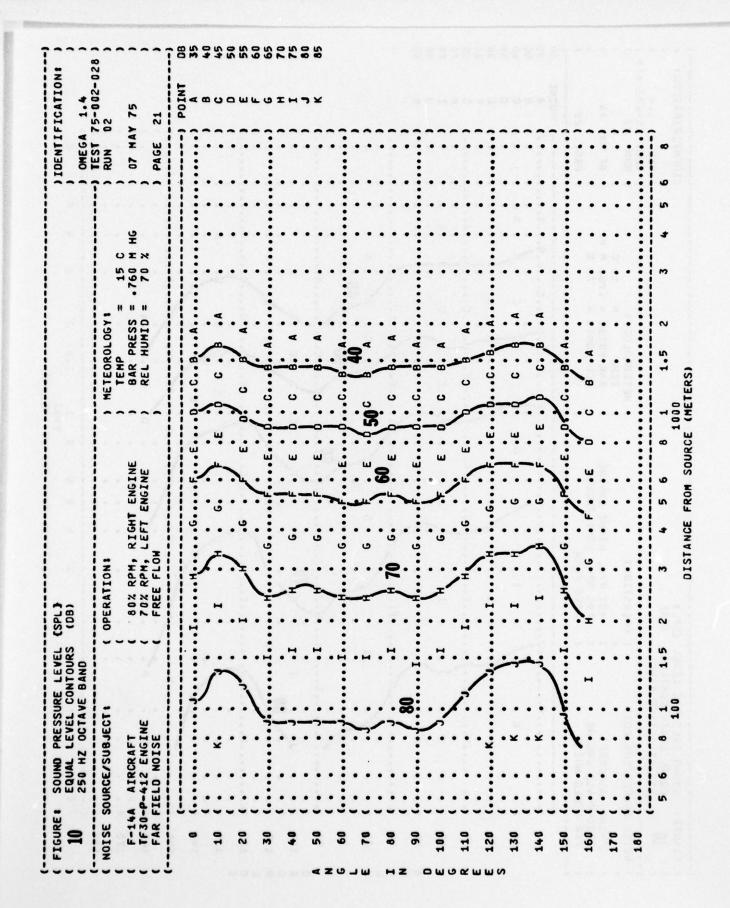
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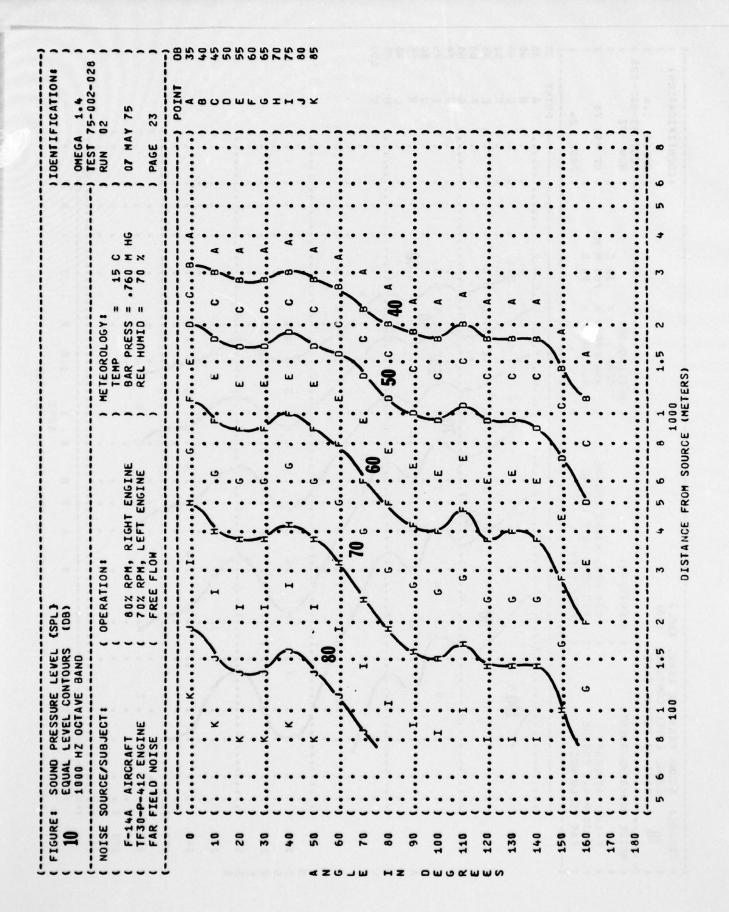


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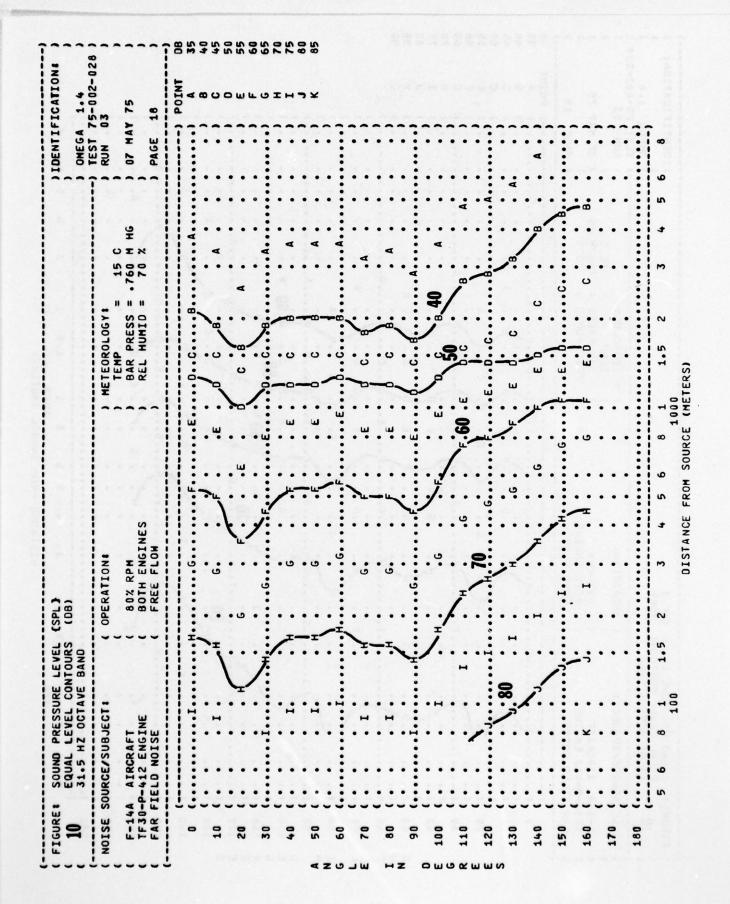
10 EQUAL LEVEL CONTOURS 500 HZ OCTAVE BAND	ONTOURS (DB) Band) ONEGA 1.4
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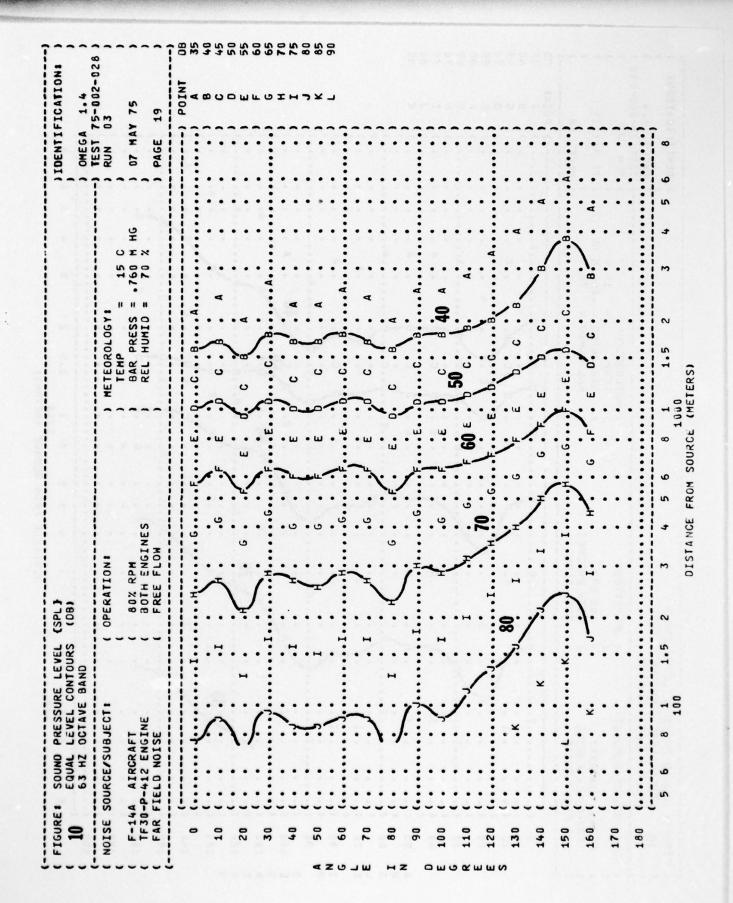


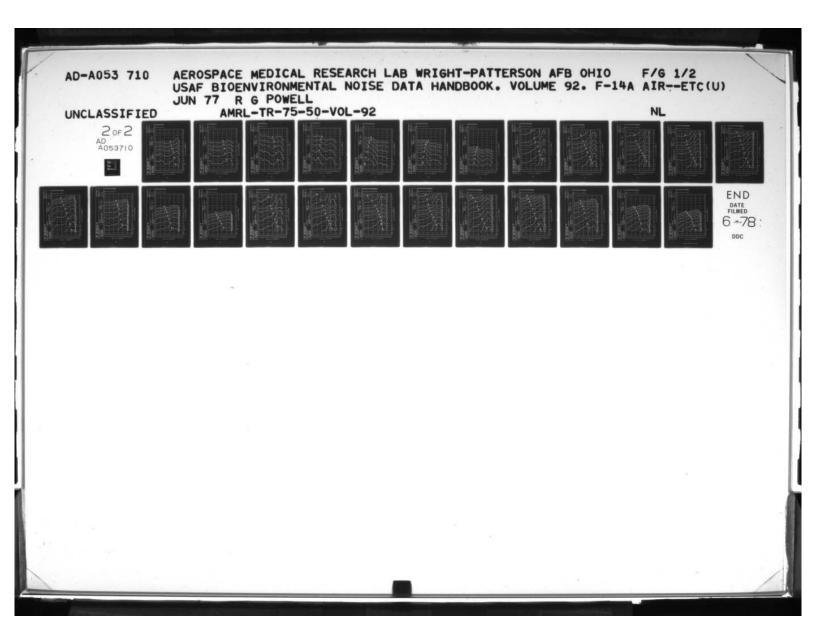
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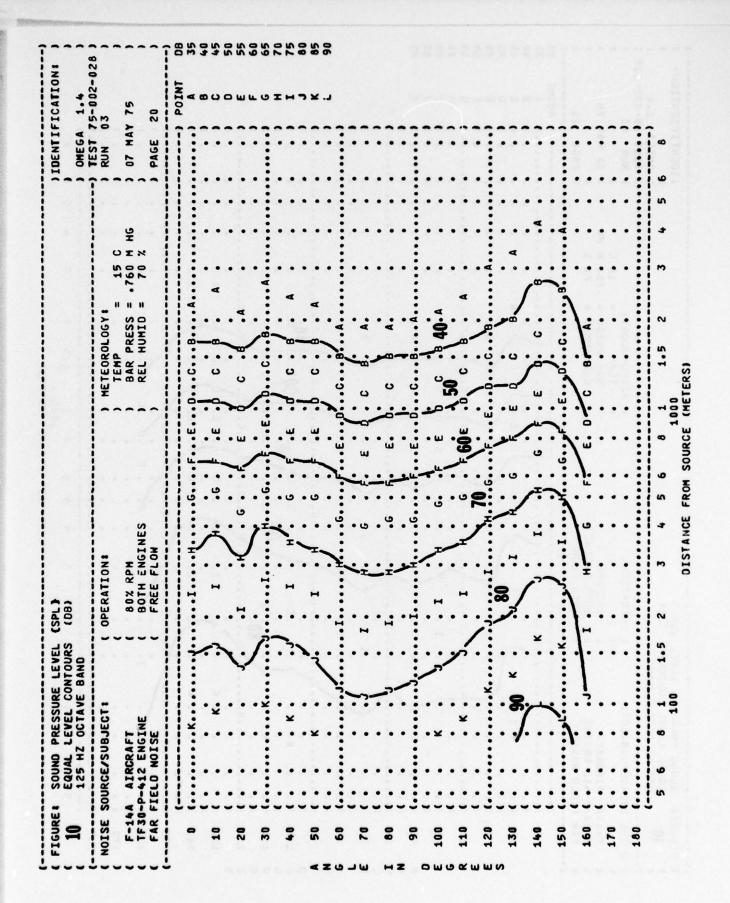
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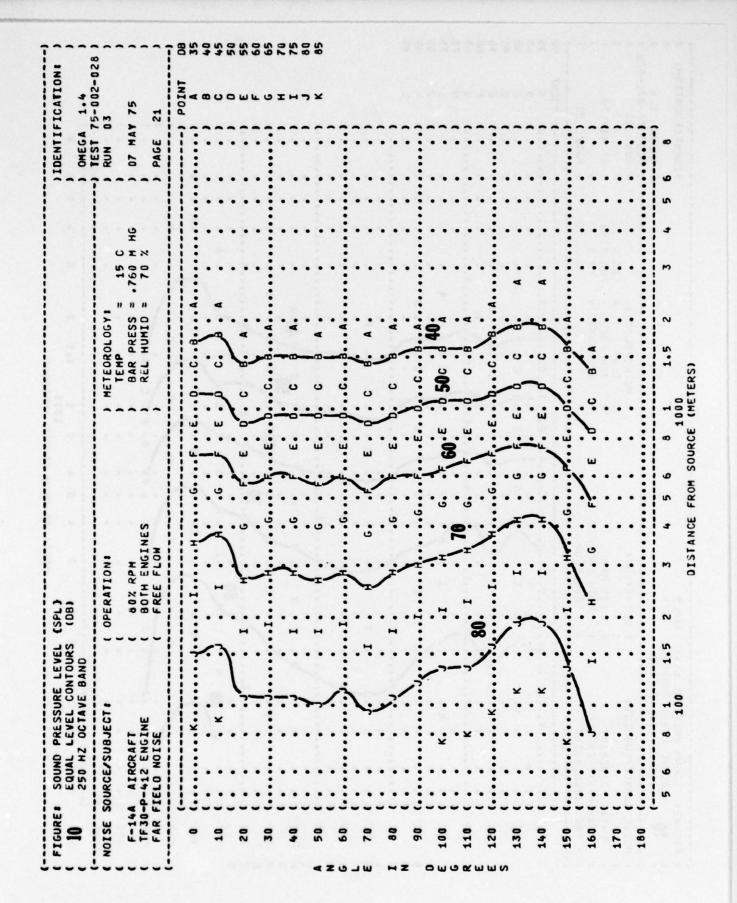
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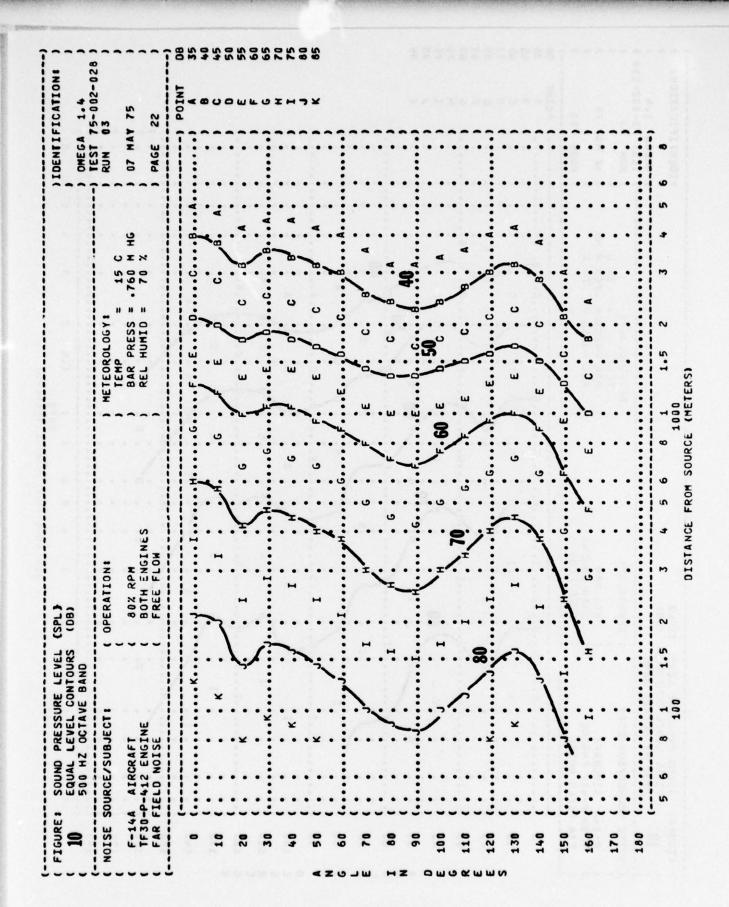


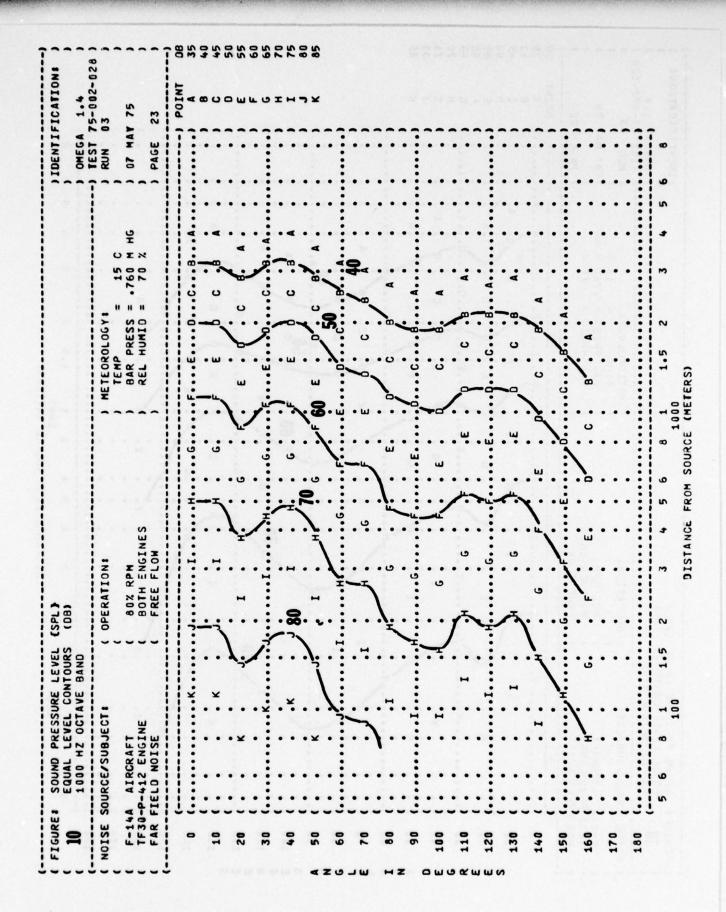


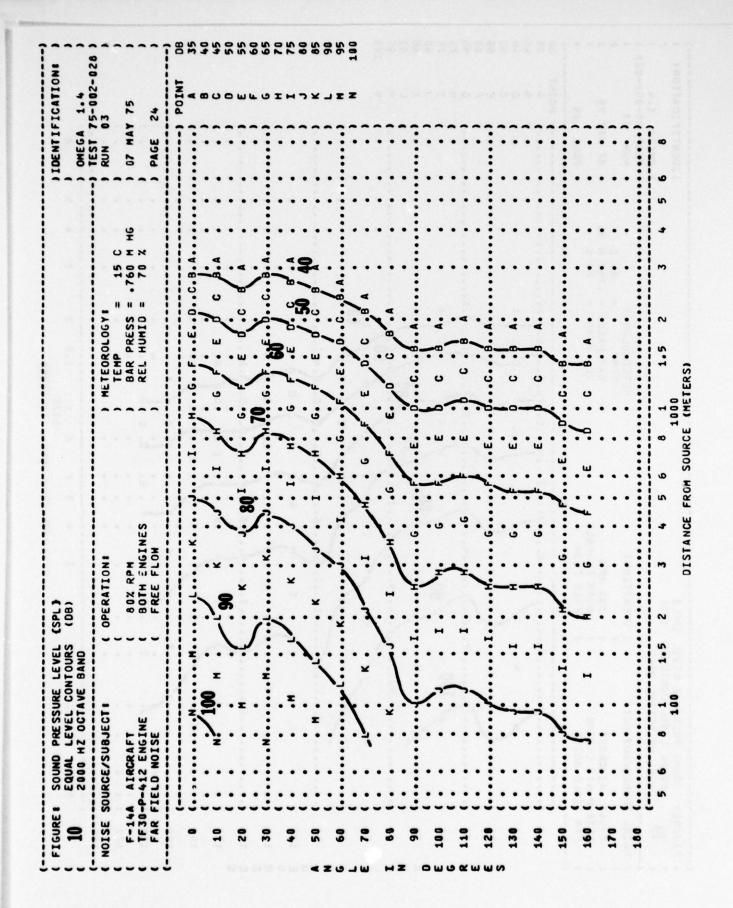


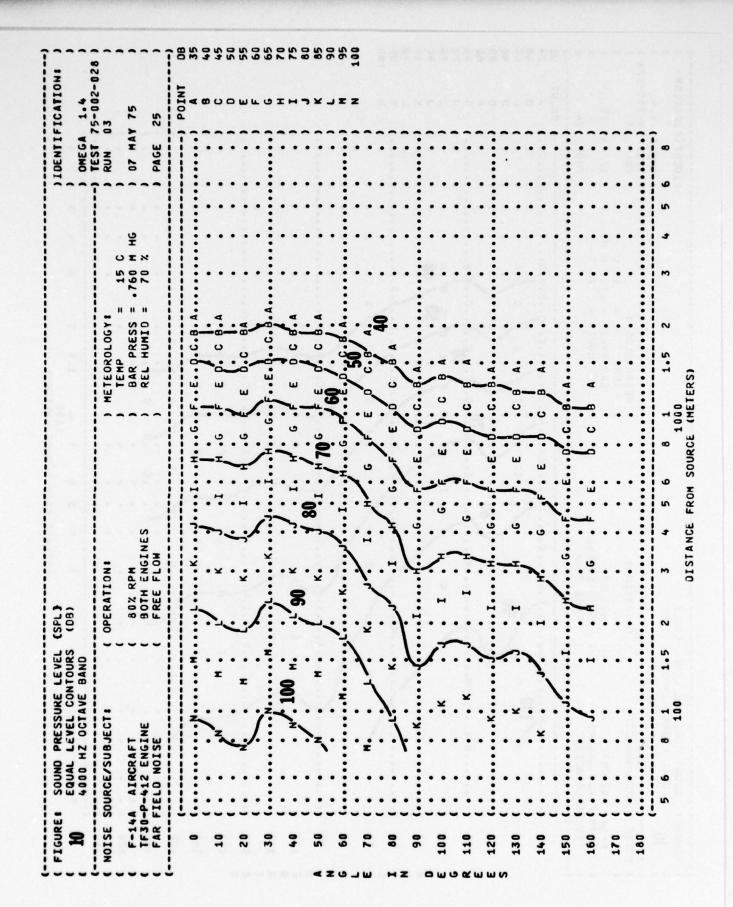












SCHIOURS (DB) VE BAND OPERATION OMEGA 1.4	03	1 07 HAY 75	PAGE 26	TNIO4 (A (·				9 (•			• • •		::	: .	•		•	•	•					•		(e	
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